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LONDON.

NEW SERIES. VOL. XIX.

SESSION 1899-1900.

LONDON:
SHAW AND SONS, FETTER LANE, E.C.

MDCCCC.

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LONDON:
PRINTED AT THE BEDFORD PRESS, 20 AND 21, BEDFORDBURY, W.C.

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1888. Brouardel, S., M.D., 195, Boulevard St. Germain, Paris.
1888. Colin, Léon, M.D., 17, Boulevard St. Germain, Paris.
1900. Fayrer, Sir Joseph, Bart., K.C.S.I., LL.D., M.D., F.R.S., Q.H.P., 15, Devonshire Street, Portland Place, W.
1868. Guipon, D. J., M.D., Laon, Aisne, France.
1885. Humphreys, Noel A., General Register Office, Somerset House, W.C.
1888. Koch, R., M.D., 36, Klosterstrasse, Berlin.
1888. Larrey, F. H., M.D., 91, Rue de Lille, Paris.
1888. MacLaurin, H. A., M.D., Macquarie Street, Sydney, N.S.W.
1888. Meijer, van Overbeek de, M.D., Utrecht.
1896. Monod, H., Paris.
1894. Müller, Coleman, M.D., St. Rochus Hospital, Buda-Pesth.
1888. Pettenkofer, Max von, M.D., Munich.
1888. Proust, A., M.D., 9, Boulevard Malesherbes, Paris.

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1888. Sternberg, Geo. M., M.D., Johns Hopkins University, Baltimore, U.S.A.
1888. Stokvis, B. J., M.D., 26, Sarphatstraat, Amsterdam.
1888. Vallin, E., M.D., 5, Avenue de Messine, Paris.

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1896. Adams, P. T., F.C.S., Great Western Hotel, Bombay.
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1900. Argles, Frank, Hermon Lodge, Wanstead, N.E.
1882. Armstrong, Henry E., D. Hy., Town Hall, Newcastle-on-Tyne.
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1884. Atkinson, F. E., Whitefriars, Settle, Yorkshire.
1896. Beggs, J. E., M.D., Grove Hospital, Tooting Grove, Lower Tooting, S.W.
1898. Blaxall, F. R., M.D., D.P.H., Jenner Institute of Preventive Medicine, Chelsea, S.W.
1897. Bond, F. T., M.D., 3, Beaufort Buildings, Gloucester.
1892. Bond, W. A., M.D., 10, Gray's Inn Place, Gray's Inn.
1889. Boobbyer, Philip, M.B., Municipal Offices, Nottingham.
1889. Brock, J. H. E., M.D., 115, Adelaide Road, N.W.
1891. Bruce, R. M., Western Hospital, Fulham.
1894. Buchanan, G. S., M.D., Local Government Board, Whitehall, S.W.
1889. Bulstrode, H. Timbrell, M.D. (*Hon. Secretary*), Local Government Board, Whitehall, S.W.
1888. Caiger, F. Foord, M.D., South Western Hospital, Stockwell.
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1897. Cantlie, James, M.B., F.R.C.S., 46, Devonshire Street, Portland Place, W.
1895. Cayley, W., M.D., 27, Wimpole Street, W.
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1866. Caddy, J. T., M.D., Dep. Inspec.-Gen., The Charterhouse, Lion Gate Gardens, Richmond, Surrey.
1887. Collins, G. W., The Mall, Wanstead, N.E.
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TRANSACTIONS

OF

The Epidemiological Society of London.

INAUGURAL ADDRESS OF SESSION 1899–1900.

On the Comparative Mortality of English Districts.

By H. FRANKLIN PARSONS, M.D., President.

(*Read: November 17th*, 1899.)

In the address which I had the honour to read before you a year ago, I recounted the history of the efforts which have been made in England during the past fifty years for the improvement and protection of the public health; and I endeavoured to estimate the degree of success which these efforts had attained. We found that—partly, no doubt, through the general amelioration of social conditions, but partly also, as there was good reason to believe, as the result of efforts specially directed towards the improvement of the public health—there had been, during the half-century under review, a marked decline of the death-rate, it having fallen from 23.1 per 1,000 inhabitants per annum in the five years 1847-51, to 18.1 in the five years 1892-96. This fall, moreover, has taken place in spite of the increasing aggregation of the population in towns, a circumstance which of itself would have tended in a contrary direction.

But the satisfaction which we might otherwise feel at this achievement is subdued when we examine the contemporary mortality statistics of different districts, for we find that at the present time the death-rate in the unhealthiest districts of England and Wales exceeds that in the unhealthiest districts by a far greater amount than that by which the death-rate of England and Wales fifty years years ago exceeded the death-rate of the present day. Thus while, as I have said, in England and Wales the average annual death-rate was 23.1 in 1847-51 and 18.1 in 1892-96, a difference of 5 per 1,000 persons living, the average annual death-rate in the great towns of England

during the ten years 1888-97 varied from 14.4 in Croydon to 25.5 in Liverpool: a difference of 10.1 per 1,000 inhabitants, or more than double the difference between the death-rates for the whole kingdom in 1847-51 and in 1892-96. If, therefore, we ascribe the reduction of mortality during the past fifty years to the improvement which has taken place in the sanitary and social conditions of the community, it is difficult to avoid the confession that the sanitary and social conditions of the most unhealthy of our towns fall short of the standard attained in the healthiest towns, in a much greater degree than that in which the sanitary and social conditions of the whole country fifty years ago fell short of those of the present day. The causes of these differences between the mortality in different districts at the present day, I propose to discuss briefly to-night.

Comparative Mortality of Town and Country Districts.

Speaking generally, the death-rate is higher in towns than in country districts, and it is higher in large towns than in smaller ones. In the ten years, 1888-97, the average annual death-rate in England and Wales was 18.4, viz.; in town districts 19.3, and in country districts 16.8.* In the three years, 1896-98, the average annual death-rates were in England and Wales 17.4 per 1,000 inhabitants, in the thirty-three largest towns 19.0, in the sixty-seven towns of next size 17.2, and in the rest of England and Wales 16.3.† The difference between the death-rates in town and country is increased when we take into consideration the constitution of the respective populations as regards age and sex: the towns have, as a rule, a larger proportion than country districts have of young inhabitants, *i.e.*, of persons at ages at which death is less frequent; and hence, *cæteris paribus*, they should show a lower death-rate than country districts; whereas, in fact, the reverse is the case. Thus, in the seven years 1892-98, the average annual death-rate recorded in the thirty-three largest towns of England and Wales was 20.2 per 1000 inhabitants, and in England and Wales less the thirty-three towns 16.9; but corrected for age and sex distribution, these rates become 21.3 in the thirty-three towns, and 16.7 in the rest of the country.‡ It is to be noted, however, that the difference between

* Sixtieth Annual Report of the Registrar-General. Table 29.
† Quarterly Reports of the Registrar-General.
‡ Annual Summaries of Weekly Reports of the Registrar-General. Table 4.

the rates of mortality in town and country districts is diminishing; the proportional rates in equal numbers living were, in 1851-60, 124 deaths in town districts to 100 deaths in country districts; in 1861-70, 126 in towns to 100 in country; in 1871-80, 122 in towns to 100 in country; in 1881-90, 117 in towns to 100 in country; and in 1891-7, 115 in towns to 100 in country.* The higher mortality in towns as compared with country districts is very largely due to the unfavourable conditions affecting child life in towns, and especially to the prevalence of infantile diarrhœa. In the three years 1896-8, the average annual death-rate in the thirty-three great towns of England and Wales was 19.0, and in England and Wales, less the one hundred largest towns, 16.3: a difference of 2.7 per 1000 persons living. Of this difference more than half, viz., 1.4, was due to the greater mortality in the large towns from the infectious and diarrhœal diseases included under the term "zymotic," which caused in the aggregate a death-rate of 2.86 per 1000 in the great towns, and 1.46 in the country, less the one hundred towns. Measles caused a mortality per 1000 persons of .61 in the great towns, and .34 in the country districts; scarlet fever caused death-rates of .18 and .12 respectively; diphtheria of .33 and .20; whooping-cough of .47 and .29; "fever" of .19 and .15; and diarrhœa of 1.08 and .50. It is noteworthy that diphtheria, which was formerly a disease of rural districts and rare in towns, is now much more fatal in the large towns than in the rural districts and small towns. It causes the largest proportional mortality in London, while some of the great provincial towns, which are unhealthy in other respects, have but a low rate of mortality from diphtheria, as Preston and Sunderland. On the other hand, "fever," a term which includes chiefly enteric fever, is now not much more prevalent in the great towns than in the country districts, but diarrhœa is nearly twice as fatal in the great towns as in the less populous districts. The sixty-seven towns of second rank occupy an intermediate position between the thirty-three great towns and the country districts, except as regards "fever," which caused an equal death-rate in the thirty-three largest towns and in the sixty-seven towns of second rank; and small-pox, which caused a higher mortality in the sixty-seven towns of second rank than in either of the other groups of districts, owing to the

* Sixtieth Annual Report of Registrar-General, p. 29.

epidemics which occurred at Gloucester and Middlesbrough. The mortality among infants in their first year of life is much larger in the great towns than in the country districts, being in the former 174 and in the latter 138 out of every 1000 born. As the birth-rate is greater in towns than in country districts, the greater proportion of those born who die during the first year of life will have so much the greater effect in raising the general death-rate. It used formerly to be a subject of warm discussion whether the tendency of a high birth-rate was to raise or to lower the death-rate. A high birth-rate implies, in order that so many children may be begotten, that a high proportion of the population must consist of married persons of reproductive age, *i.e.*, of persons at ages at which the mortality is low; and though the mortality among young children is higher than that at the age-periods next following, yet where the conditions of life are favourable, a comparatively large proportion of those born will survive to the years of childhood at which mortality is at its lowest. Hence, where sanitary and social conditions are favourable, the existence of a high birth-rate indicates that the age-constitution of the population is such that the death-rate ought to be low. On the other hand, where sanitary and social conditions are unfavourable, a large proportion of the children born die in infancy, and do not reach the ages of low mortality, nor live to be enumerated among the population.

Comparative Mortality in different Counties.

If now we compare the death-rates prevailing in different parts of the kingdom, we find differences between the death-rate in one part and that in another part, greater than the difference between the aggregate death-rate of the great towns and that of the country districts. Thus, during the ten years 1887-96, the average annual death-rate per 1000 persons living, varied in the eleven divisions of the Registrar-General from 15.8 in the South Eastern, and 15.9 in the South Midland divisions, to 19.0 in Yorkshire, 19.3 in Wales, 19.6 in London, and 20.9 in the North Western division. In the individual registration counties the range was, of course, still greater, viz.: from 14.8 in Surrey, to 21.8 in Lancashire (see Map I and Table XV). If the crude death-rates be corrected for age and sex, by applying the actual death-rates in each county, at each age-period, to an equal population of standard age and sex constitution, the disparity between the death-

rates in different counties is increased; for the agricultural counties, which have low death-rates, have a larger proportion of elderly inhabitants, as compared with the urban and industrial counties; and hence the result of the correction is to reduce the comparative mortality figure in the former, and to increase it in the latter. The order of the counties is also somewhat altered: Rutlandshire comes first with a rate of 13.2; Huntingdonshire, Cambridgeshire and Dorsetshire also have rates below 14.0, and eight other counties have rates below 15.0. On the other hand, the rate in Lancashire is increased to 23.6, and the West Riding, London and Durham all have rates above 20.

A line drawn across England, from the mouth of the Severn to the Wash, will roughly divide the counties of high mortality from those of low mortality. The Registrar-General's divisions I to V, viz., London, South Eastern, South Midland, Eastern and South Western, containing 22 counties or vice-counties, lie to the S.E. of this line, and divisions VI to XI, viz., the West Midland, North Midland, North Western, Yorkshire, Northern and Wales, containing 23 counties or vice-counties, lie to the N.W. of it. All the counties with crude death-rates under 16, with the exception of Westmoreland, lie to the S.E. of this line, and all the counties with death-rates above 18 lie to the N.W. of the same line, except London and Cornwall. Speaking generally, the counties which are purely agricultural and contain no large towns have low death-rates; this is so with Rutlandshire in the North Midland, and with Westmoreland in the Northern division; though other counties in those divisions, which contain large towns and manufacturing or mining populations, have much higher death-rates. On the other hand, the counties which have a high death-rate are those which contain a predominant urban population, and especially a manufacturing or mining one, *e.g.*, London, which is wholly urban, with a density of population in 1891 of 56.5 persons to an acre, and Lancashire, Staffordshire, Warwickshire, the West Riding of Yorkshire, Durham, Northumberland, Monmouthshire, and South Wales, with their great towns and populous mining and manufacturing communities. It may be remarked that a high mortality prevails in those parts of the kingdom in which there is a considerable Celtic element in the population, as Wales and Monmouthshire, and to a less extent in Cornwall, and also in the large towns of Lancashire in which there are many Irish, as Liverpool and Preston. It may be remarked,

too, that the line between the counties of low and of high mortality corresponds approximately with the lower border of the outcrop of the Jurassic system of rocks; except in Lincolnshire and Yorkshire, the areas occupied by the Oolitic, Cretaceous, and Tertiary strata lie to the S.E. of that line in the region of low mortality; while the areas occupied by the new red sandstone, the coal measures, and the older Palæozoic rocks lie to the N.W. of the line in the region of high mortality. In the S.E. half of the kingdom the principal water supplies are usually derived from springs or wells in the chalk or the Oolitic limestones; whereas, in the N.W. half, most of the large towns and the surrounding populous districts are supplied with upland surface water; hence, in the former region we may say, that the bulk of the population drink hard water, in the latter soft water. It would, however, be going too far to attribute the low or the high death-rate to the presence or absence of lime in the drinking water, for there are towns which, like Cardiff and Huddersfield, are supplied mainly or wholly with soft water, and have a low death-rate; while there are others which, like Sunderland, are supplied with hard water and have a high death-rate. London, however, which is supplied with hard water, can hardly be considered an exception to the rule: for, in spite of its size and density of population, its death-rate is below the average of the largest towns, and far below the death-rates of Liverpool and Manchester, the two towns which come next to it in population, and which are supplied with soft water. London, it may be noted, ranks both as a county and a town. As a county it has a high death-rate compared with other counties, for these contain large rural areas, while London is wholly urban; but as a town, compared with other large towns, its death-rate is low, especially considering its vast extent and closely-aggregated population.

In the N.W. half of the kingdom, the birth-rate is considerably higher than in the S.E. half. In registration divisions I to V, *i.e.*, London, S.E., S. Mid., E. and S.W., in nineteen counties out of twenty-two, the average annual birth-rate in the ten years 1887-96, was under 30 per 1000 inhabitants, and in only three, viz.: London, Essex, and Northamptonshire, was it above 30. In registration divisions VI to XI, viz.: W. Mid., N. Mid., N.W., Yorks., N., and Wales, out of twenty-three counties, in eight the birth-rate was below 30, and in fifteen above 30, per 1000 inhabitants (see Map II).

TABLE I.—1887-96.

Registration Divisions.	Counties in which Birth-rate per 1000 inhabitants was above— 24	25	26	27	28	29	30	31	32	33	34	35	36
I to V ...	—	2	3	9	3	2	1	2	—	—	—	—	—
VI to XI ...	1	—	2	2	2	1	4	2	4	2	1	1	1

The proportion of infants who die in their first year of life is greater in the N.W. than in the S.E. half of the kingdom. During the years 1887-96, in the twenty-two counties of registration divisions, I-V, the proportion of deaths under one year old to 100 births, was less than 14 in twenty-one counties, and above 14 in one only, viz.: in London, where it was 15.5. In the twenty-three counties of registration divisions VI-XI, the proportion was below 14 in eight counties, and above 14 in fifteen, the highest rate being 17.3 in Lancashire (see Map III).

TABLE II.—1887-96.

Registration Divisions.	Counties in which Infant Mortality per 100 Births was above— 9	10	11	12	13	14	15	16	17
I to V ...	1	3	8	4	5	—	1	—	—
VI to XI ...	—	1	3	3	1	4	6	4	1

If then in the N.W. half of the kingdom a greater proportion of children are born to a given number of inhabitants than in the S.E. half, and of those born a greater proportion die in the first year of life, we have in these circumstances a partial explanation of the higher death-rates in the former than in the latter portion of the kingdom.

The higher birth-rate in the divisions of the kingdom which contain the principal manufacturing and mining centres will also partly explain the circumstance that these are the divisions which experience the highest mortality from the most fatal infective and diarrhœal diseases of childhood. Whooping-cough and diarrhœa are most fatal in the first year of life; measles in the second year; scarlet fever and diphtheria in the third and fourth years of life; and therefore we might expect that these diseases would find their largest number of victims in the districts where the birth-rate was highest, and in which, therefore, children of susceptible ages were relatively most numerous.

Among other circumstances which may be thought of as conducing to the greater fatality of the infectious diseases of childhood in the manufacturing and mining counties, are the popular fatalism and recklessness as regards infection which, as my experience has led me to believe, prevail

there, as compared with the greater carefulness in this respect usual in the south; the frequency of yards common to a number of houses, an arrangement which facilitates the spread of infection from household to household; and the less favourable circumstances in which child life is placed when the mother goes out to work in a factory.

From *Measles* the average annual death-rate per 1000 inhabitants during the ten years 1887-96 in the counties of the first group was under .4 in nineteen, and over .4 in three; while in the counties of the second group it was under .4 in ten, and over .4 in thirteen (see Map IV).

TABLE III.—1887-96.

Registration Divisions.	Counties in which the Average Annual Death-rate per 1000 Inhabitants from Measles was above—					
	.1	.2	.3	.4	.5	.6
I to V. ...	2	12	5	2	—	1
VI to XI ...	5	2	3	8	4	1

The counties in which the measles death-rate was highest were Lancashire, London, Staffordshire, Durham, Cumberland and Monmouthshire, all largely urban, manufacturing or mining; while those in which the measles death-rate was lowest were Huntingdonshire, Rutland, Cambridgeshire and Herefordshire, all agricultural counties.

From *Scarlet fever*, the average annual death-rate during the same period in counties of the first group was under .1 per 1000 inhabitants in fourteen, and above ·1 in eight. In the counties of the second group, the scarlet fever death-rate was under .1 in three, and over .1 in twenty.

TABLE IV.—1887-96.

Registration Divisions.	Counties in which the Average Annual Death-rate per 1000 Inhabitants from Scarlet Fever was—			
	Under .1	.1	.2	.3
I to V ...	14	6	2	—
VI to XI ...	3	11	7	2

The counties in which the death-rate was highest were Lancashire, South Wales, the West Riding, and Monmouthshire; those in which it was lowest were Sussex, Surrey, Suffolk, Oxfordshire and Dorset.

The mortality from *Whooping-cough* was somewhat more evenly distributed; but the counties in which it was highest, viz., London, Lancashire, Warwickshire, Monmouthshire and Cornwall, are urban, manufacturing, or mining; and those in which it was lowest, viz., Westmoreland, Dorset, Wiltshire and Berkshire, are agricultural.

TABLE V.—1887-96.

Registration Divisions.	Counties in which the Average Annual Death-rate from Whooping-cough per 1000 Inhabitants was—				
	.1	.2	.3	.4	.5
I to V ...	1	8	9	3	1
VI to XI ...	1	4	11	6	1

From *Diarrhœa* the death-rate varied greatly in different parts of the country during the ten years 1887-96; the average rate in Leicestershire (1.0 per 1000 inhabitants) was five times as great as that (.2) in the adjoining county of Rutland.

TABLE VI.—1887-96.

Registration Divisions.	Counties in which the Average Annual Death-rate from Diarrhœa, per 1000 Inhabitants was—								
	.2	.3	.4	.5	.6	.7	.8	.9	1.0
I to V ...	3	11	5	2	1	—	—	—	—
VI to XI ...	4	4	1	5	1	3	2	2	1

The counties in which the diarrhœal death-rate was highest were Leicestershire, the East Riding, Lancashire, Warwickshire, Staffordshire, Durham, Nottinghamshire, the West Riding, and London; those in which it was lowest were Rutland, Westmoreland, Hereford, Wilts. and Dorset (see Map V).

The distribution of *Enteric fever* is similar to that of diarrhœa, being high in the manufacturing and mining counties of the north and midlands, and low in the agricultural counties of the south (see Map VI).

TABLE VII.—1887-96.

Registration Divisions.	Counties in which the Average Annual Death-rate from Enteric Fever per 1000 Inhabitants was—			
	Under .1	.1	.2	.3
1 to V. ...	8	14	—	—
VI to XI ...	3	12	7	1

The county in which the mortality from enteric fever was highest was Durham; next come Lancashire, Nottinghamshire, and the North Riding; and after these Cheshire, the East and West Ridings, Leicestershire, and South Wales. It was lowest in Herefordshire, Rutlandshire, Wiltshire and Oxfordshire and in other agricultural counties, and, unlike the death-rate from diarrhœa, it was comparatively low in London. Generally speaking, we may say that enteric fever is most fatal in the parts of England in which the midden-privy is the prevailing method of excrement

disposal. Water-closets are in general use in most southern towns; and in country places, for some reason or other, the vault-privy of the south of England does not seem to favour the spread of enteric fever so much as the midden-privy of the north.

In its distribution *Diphtheria* follows no such rule as do either the diarrhœal or the more specially infectious diseases. Although diphtheria presents points of resemblance to scarlet fever in its clinical features and in its age-incidence, and the two diseases are, indeed, not unfrequently found in association with each other, yet their geographical distribution, as Dr. Longstaff has pointed out, is quite different; the counties which have a high mortality from the one having in many instances a low mortality from the other. Thus Sussex, Suffolk, and Surrey, which are among the counties having the lowest death-rates from scarlet fever, have all high death-rates from diphtheria. The West Riding, which has a high death-rate from scarlet fever, has a low one for diphtheria; and Lancashire, with the highest death-rate from scarlet fever of any county, has only a moderate one from diphtheria. London, Middlesex, and Monmouthshire, however, have high death-rates from both diseases. Generally speaking, the mortality from diphtheria during the years 1887-96 was lower in the populous mining and manufacturing counties of the north than in the agricultural counties of the south. But it is a peculiar feature of diphtheria that it is apt from time to time to attack particular localities in the form of protracted or recurring epidemics; and again, after being prevalent there for a series of years, it may subsequently die out, and the locality then remain for a term of years comparatively free from diphtheria.

One such focus of the disease at present is to be found in London and the neighbouring counties, and another in South Wales; and in both of these regions the disease has in recent years been prevalent in large urban communities. Indeed, as I have before mentioned, diphtheria, which was formerly specially a disease of country districts, is now becoming more and more a disease of towns.

TABLE VIII.—1887-96.

Registration Divisions.	Counties in which the Average Annual Death-rate from Diphtheria per 1000 Inhabitants was—			
	.1	.2	.3	.4
I to V ...	11	9	—	2
VI to XI ...	22	1	—	—

The two highest were London and Essex (see Map VII).

Influenza.—The county death-rates from this disease are not given in the reports of the Registrar-General. I have, however, calculated them, taking the period of eight years from the first reappearance of the disease as a notable cause of mortality in 1890 to 1897, the latest year for which figures are available.

TABLE IX.—1890-97.

Registration Divisions.	Counties in which the Average Annual Death-rate from Influenza per 1000 Inhabitants was—					
	Below .2	.2	.3	.4	.5	.6
I to V ...	—	—	14	7	1	—
VI to XI ...	1	9	6	5	1	1

The counties in which the influenza death-rate was highest were, in order: Herefordshire, Shropshire, Wiltshire, Westmoreland, North Wales, Rutland, Northamptonshire and Buckinghamshire. The counties in which it was lowest were, in order: Durham, Northumberland, Leicestershire, Lancashire, Staffordshire, Nottinghamshire, and South Wales. In a paper which I had the honour to read before the Society in 1894, "On the Distribution of the Mortality from Influenza in England and Wales," I said: "Speaking generally, we may say that the mortality from influenza was below the average in the manufacturing and mining counties of the North and Midlands, and above the average in the Southern and Midland agricultural counties, and in the hilly counties towards the west coast." These words, which referred to the mortality during the three years 1890-92, hold good for the more extended period now under review, the order in which the counties stand having hardly altered (see Map VIII).

The mortality from *Phthisis* is somewhat equally distributed among the different counties, the average annual death-rate from this disease in the ten years 1887-96 ranging between 1.08 per 1000 inhabitants in Worcestershire and Rutlandshire, and 1.89 per 1000 in Northumberland. It was also high in London, North and South Wales, Lancashire and the West Riding, and low in Westmoreland and Buckinghamshire.

The deaths from *diseases of the respiratory organs* form a large item in the total mortality: during the ten years 1887-96, they equalled an average annual rate of 3.5 per 1000 inhabitants out of a total death-rate of 18.6; that is to say, a mortality nearly a fifth of the whole, and more than half as large again as the aggregate mortality (2.1) caused by the "seven principal zymotic diseases."

TABLE X.—1887-96.

Registration Divisions.	Counties in which the Average Annual Death-rate from Diseases of the Respiratory Organs per 1000 Inhabitants was—					
	2.0-2.5.	2.5-3.0.	3.0-3.5.	3.5-4.0.	4.0-4.5.	Above 4.5.
I to V ...	—	18	3	—	1	—
VI to XI ...	2	3	10	4	3	1

The counties which had the highest death-rate from these diseases were: Lancashire, 4.9; Monmouthshire, 4.2; the West Riding and Staffordshire, 4.1; and London, 4.0. The counties with the lowest death-rates were: Rutland and Westmoreland, 2.3; Norfolk, Cambridgeshire, Oxfordshire and Hertfordshire, 2.6; and Bucks, Lincolnshire, Suffolk and Dorset, 2.7. Generally speaking, it may be said that the mortality was low in the agricultural counties, and high in the counties containing large smoky towns, and especially in those in which the inhabitants are largely engaged in dusty occupations. Thus, in Staffordshire the death-rate from respiratory diseases was 4.1 per 1000, in Leicestershire it was only 3.0. Both are manufacturing counties; but in Leicestershire the staple industries are bootmaking and stocking-weaving, clean trades which do not employ great mechanical power in proportion to the number of hands engaged; while in Staffordshire the heavy iron trade and the pottery works require great furnaces, and are responsible for a large amount of smoke, and some branches of the pottery manufacture are exceedingly dusty.

The mortality from diseases of the respiratory organs is chiefly made up of the two items of bronchitis and pneumonia, and a fourth part of the mortality under this heading takes place in the first year of life. Hence, the mortality from diseases of the respiratory organs will tend to be high where the birth-rate is high, and where child life is under unfavourable conditions. But this consideration will not account for the whole of the difference between the mortality from respiratory diseases in one and another county. Thus, the birth-rate and the infant mortality per 100 births were both, in the ten years 1887-96, higher in the East Riding than in the West Riding; yet the death-rate from respiratory diseases in the West Riding was 4.1, and in the East Riding only 3.3; the higher mortality in the West Riding being probably attributable to town smoke and to the dusty occupations in which many of the inhabitants are employed.

Notwithstanding the frequency with which influenza is

followed by inflammations of the lungs, and the great mortality from these affections during epidemics of influenza, no direct relation is apparent between the mortality in different counties from influenza and that from diseases of the respiratory organs. The reason is doubtless to be found in the different periods of life at which the principal mortality occurs, influenza being most fatal at the later life periods, and therefore in counties containing a large proportion of elderly persons.

Diseases of the heart and circulatory system, being largely due to the degenerative changes of advancing years, are fatal chiefly to persons in the later periods of life ; and hence we might expect to find the mortality from these diseases greatest in the counties in which elderly persons predominate—that is to say, in the agricultural counties. This is, to some extent, the case; but the counties in which the mortality from diseases of the heart and bloodvessels is highest are the hilly counties of the West—viz., those of the S.W. division, Gloucestershire, Herefordshire, Shropshire, Cumberland, Westmoreland, and North Wales. In the ten years, 1887-96, the highest rate was 2.3 in Herefordshire, and the lowest 1.2 in Middlesex.

Cancer.—The various forms of malignant disease also attack chiefly people in the middle and later stages of life; hence, we find that cancer occasions a greater mortality in a population containing a larger proportion of persons at such ages, than in one in which children and young adults preponderate. During the ten years 1887-96, the average annual death-rate from cancer per 1000 inhabitants was 1.11 in Huntingdonshire, .92 in Cambridgeshire, and above .80 in North Wales, Rutland, Herefordshire, Devonshire, Shropshire, Norfolk, Sussex and Cornwall. It was only .53 in Durham, and was below .60 also in Monmouthshire, Derbyshire, Staffordshire and Lancashire. These latter are all counties having a high birth-rate, and their population must, therefore, contain a large proportion of children, and of adults at the reproductive age ; whereas the counties with a high cancer death-rate have all low birth-rates. Of the counties in the South of England, Essex and Middlesex are the only ones with a cancer death-rate below .7 per 1000 inhabitants: Essex has a comparatively high birth-rate, and part of the cancer mortality of both Essex and Middlesex, as well as of other home counties, is probably transferred to London, through persons from those counties dying in Metropolitan hos-

pitals. It has been contended by Mr. Haviland that cancer mortality is greatest in alluvial districts, near large estuaries. The high cancer mortality in Huntingdonshire and Cambridgeshire (which, as the Registrar-General has pointed out,* form with the adjacent low-lying parts of Northamptonshire and Lincolnshire a distinct cancer area), is in favour of this view, but the low mortality in Essex is against it, and in the other counties which I have mentioned as having a high cancer death-rate, no large proportion of the population resides on alluvial soil.

It may be of interest to compare the two counties at the opposite ends of the scale of mortality—viz., Surrey, with an average annual crude death-rate in 1887-96 of 14.8 per 1000 inhabitants, and Lancashire, with an average rate of 21.8 —nearly half as much again—and note what are the principal factors which go to make up the excess in the latter county. When the death-rates in the two counties are corrected for the age and sex-constitution of their respective populations, that of Surrey is raised to 15.0, and that of Lancashire to 23.6. Surrey thus loses its place at the head of the list of English counties, which is taken by Rutland with a corrected death-rate of 13.2; followed close by Huntingdon, Cambridgeshire and Dorset; but, on the other hand, the bad pre-eminence of Lancashire is increased, the counties with the next highest corrected death-rates being the West Riding (20.8) and Durham (20.1). As regards the physical features of these two counties, we may observe that in Surrey the greater number of the inhabitants reside on porous soils, as the alluvial and tertiary gravels, the chalk and green sand; while in Lancashire probably the greater number reside on the clays of the coal measures and the boulder clay; and that in Surrey people are supplied mostly with hard water from the chalk or the Thames, while Lancashire people mostly use soft upland water. In Surrey, the density of population is 1.4 persons per acre; in Lancashire 3.3. In Surrey, 60 per cent. of the population in 1891 lived in urban districts, and 40 per cent. in rural districts; the density being 7.6 persons per acre in the urban districts, and .75 persons per acre in the rural districts. In Lancashire, 92 per cent. of the population lived in urban districts, and only 8 per cent. in rural districts; the average number of persons per acre being 8.9 in the urban, and

* Supplement to Fifty-fifth Annual Report, Part I.

only .35 in the rural districts. There is also in Lancashire a considerably greater tendency than in Surrey to overcrowding in houses. Taking the Registrar - General's standard of overcrowding in tenements—viz., a proportion of more than two persons per room—we find that in Surrey less than a third, and in Lancashire more than half, of the tenements consist of fewer than five rooms, and that the proportion which are overcrowded, in the above sense, is much greater in the latter county.

TABLE XI.

Rooms.	SURREY.		LANCASHIRE.	
	Percentage of Total Tenements.	Percentage of such Tenements overcrowded.	Percentage of Total Tenements.	Percentage of such Tenements overcrowded.
1	3.6	13.7	1.18	33.9
2	6.2	10.4	7.7	26.1
3	6.6	7.25	6.2	17.7
4	15.8	4.15	38.5	5.7
	32.2	35.5	54.2	83.4

The population of Lancashire has on the whole a younger age-constitution than that of Surrey ; the proportion of persons under five years old being, in Surrey 11.3, and in Lancashire 12.5 per cent.; while persons over sixty form in Surrey 7.5 per cent., and in Lancashire 5.7 per cent., of the population.

Marriages are more frequent in Lancashire, the average annual rate of persons married being, during the ten years 1887-96, 12.6 in Surrey and 16.1 in Lancashire. Of the women living in Surrey at ages fifteen to forty-five, 40 per cent. are married ; in Lancashire, 47.6 per cent. Female domestic servants, who are usually unmarried, constitute 15.8 per cent. of the total female population in Surrey, and 6.3 per cent. in Lancashire. Of 1000 females married in the ten years 1887-96, 131 in Surrey and 193 in Lancashire were under twenty-one years of age. Yet notwithstanding the tendency to early marriage in Lancashire, the proportion of illegitimate children is slightly higher than in Surrey: 4.2 per cent. as against 4.0 per cent., and

the death-rate from venereal diseases is also higher. Popular education is more backward in Lancashire than in Surrey, especially among women. During the ten years 1887-96, of 1000 males married, 37 signed the marriage register by mark in Surrey, and 60 in Lancashire; of 1000 females married, 24 signed by mark in Surrey, and 99 in Lancashire. Of the females in Lancashire, 13.7 per cent. were returned in 1891 as engaged in the cotton manufacture.

Among the children thus born of immature, improvident and ignorant parents, and largely deprived of proper maternal care, it is not to be wondered at that many fail to survive. Of 1000 infants born, 173 in Lancashire die within their first year of life, against only 113 in Surrey. Multiplying the birth-rate by the proportion of infants who die within their first year, we get for every 1000 of the population 2.9 deaths of infants under one year old in Surrey, and 5.5 in Lancashire.

But the heavier mortality in Lancashire is not confined to infants; it affects persons of all ages except extreme old age, as the following Table shows:

TABLE XII.—1887-96.

Average Annual Death-rates per 1000 persons living at each of the undermentioned ages—

	0	5	10	15	20	25	35	45	55	65	75	85
Surrey ..	37.1	3.6	2.2	3.1	4.1	5.8	9.7	15.9	27.8	59.3	131.6	284.6
Lancashire ..	69.0	5.7	3.1	4.5	5.6	8.1	14 0	23.4	43.4	88.0	163.4	280.1

Table XIII shows the average annual rates of mortality in the two counties during the ten years 1887-96, from the principal causes of death.

It will be seen that in Lancashire the death-rate from almost every cause exceeded that in Surrey. To the total excess of 7 per 1000 in Lancashire, deaths from the seven principal zymotic diseases together contributed a quota of 1.60; tubercular diseases .62; and diseases of the respiratory organs 2.50. The only diseases in the list which caused a lower proportional mortality in Lancashire than in Surrey are diphtheria, influenza, cancer, and nervous diseases other than convulsions. The less fatality from adult nervous diseases in what would appear to be—so far as the masses are concerned—the less-educated community, is worthy of notice, though the difference is small.

Alcoholic diseases, venereal diseases, puerperal diseases, childbirth, premature birth, and congenital malformations are all proportionally more fatal in Lancashire than in

Surrey. The greater proportion of deaths in childbirth may possibly be in part an after-result of the prevalence of rickets, a disease common among badly-nourished children, but which makes little show in mortality statistics as a direct cause of death. We are prepared to find deaths

TABLE XIII.—*Average Annual Death-rates per* 1000 *Inhabitants*, 1887-96.

——	Surrey.	Lancashire.	Excess in Lancashire.		Excess in Surrey.
Small-pox	.00	.01	.01		
Measles	.28	.66	.38		
Scarlet fever	.06	.36	.30		
Fever	.10	.30	.20	1.60	
Diphtheria	.26	.20	—		.06
Whooping-cough ...	.32	.50	.18		
Diarrhœa	.33	.92	.59		
Phthisis	1.36	1.70	.34		
Tabes mesenterica ...	.15	.30	.15	.62	
Other tubercular diseases ...	.34	.47	.13		
Respiratory diseases ...	2.41	4.91	2.50		
Influenza (1890-97) ...	.38	.26	—		.12
Cancer	.70	.57	—		.13
Diseases of circulation ...	1.58	1.67	.09		
„ digestive system	.89	1.33	.44		
„ urinary system...	.40	.47	.07		
„ generative system	.04	.05	.01		
Venereal diseases ...	.06	.09	.03		
Puerperal diseases ...	.05	.10	.05		
Childbirth	.05	.09	.04		
Premature birth ...	.46	.59	.13		
Other congenital affections ...	.09	.12	.03		
Debility	.37	.83	.46		
Convulsions and laryngismus	.38	.90	.52		
Other nervous diseases ...	1.85	1.75	—		.10
Alcoholism and cirrhosis of liver.	.06	.10	.04		
Violence	.52	.74	.22		
Old age	.68	.72	.04		
Other causes	.63	1.09	.46		
Total ...	14.80	21.80	7.41		.41
		14.80	.41		
		7.00	7.00		

from violence more numerous in a coal-mining and manufacturing county, but one would hardly have expected to find a larger proportion, however slight, of deaths from old age in Lancashire than in Surrey.

The question now arises, what are the circumstances

which conduce to the prevalence of the diseases to which the high mortality of Lancashire is due? Some of these, already alluded to, are of a social nature, and little under control by local authorities. Others fall within the category of sanitary conditions, as commonly understood. In Lancashire a great increase of population, due to the development of cotton-spinning, took place in the earlier part of the present century, before public attention had been given to questions of health; and the houses erected at that period for people of the working class were often constructed with little consideration beyond that of getting the largest return for the money. Hence, in the older parts of Lancashire towns, the structure and arrangement of the dwellings of the poorer classes are often very defective. In some Lancashire districts which I have visited, a common defect of the houses is that the windows are not made to open, or at most open only to an inadequate extent. The frequent arrangement of houses with a common court or back yard favours the propagation of infectious disease, as also do the careless habits, in many cases, of the people. The prevalence of the midden-privy has doubtless much to do with the prevalence of enteric fever and diarrhœa. The older middens are often deep and wet, with porous walls, and in the act of emptying them it is a common practice to throw out their contents (a mixture of excrement, ashes and filthy liquid) on to the surface of the yard, then to wheel the stuff away and deposit it in the street, and finally to shovel it up into the scavenger's cart. This process necessarily causes great fouling of the surface of the ground about houses, especially if unpaved; and it is easy to see how specific infection may be carried about, *e.g.*, on feet, in the form of dust, or by flies; and through food or otherwise be introduced into the human body.

The prevalent habit of keeping animals also conduces to a foul state of the precincts of houses; the Lancashire working-man has commonly little taste for gardening, which indeed the soil and atmosphere do not encourage; but he delights in keeping pigeons, rabbits, and other live stock.

In many Lancashire towns, and especially in Liverpool, there are quarters inhabited by low-class Irish, who live in poverty and great squalor, and among whom typhus fever still occurs.

The staple occupations in Lancashire are less healthy than those in Surrey. Thus, in 1891, in the former county 12.4 per cent. of the males were cotton operatives, and

5.4 per cent. coalminers: occupations which are practically unrepresented in Surrey, and which have a high mortality; the comparative mortality figure of the former being 1141 and of the latter 1069; that of all males being 1000. On the contrary, farmers, gardeners, and agricultural labourers —healthy classes, with comparative mortality figures respectively of 563, 553, and 666—formed collectively 12 per cent. of the population in Surrey, and only 3.3 per cent. in Lancashire. Cotton operatives are especially prone to bronchitis and other diseases of the respiratory organs, attributable to working in dust and in steam-heated weaving sheds, with subsequent exposure to cold air.

But in fairness to Lancashire I ought to add that I have good reason to believe that at the present time the local authorities of, at any rate, most of the more important places are thoroughly in earnest in seeking to improve the sanitary state of their districts. No county, indeed, has exhibited greater enterprise in carrying out works for the promotion of the public health: witness the magnificent water supplies of Liverpool and Manchester. Several Lancashire towns are endeavouring to disestablish the midden-privy, and many have provided efficient hospitals for the isolation of infectious diseases. The death-rate, which in the ten years 1867-76 was 26.7, has fallen to 23.0 in 1877-86, and 21.8 in 1887-96; and we may confidently hope that it will be still further reduced as the effect of the sanitary work now in progress makes itself felt.

Another pair of counties which we may contrast are Dorsetshire and Durham. Dorsetshire is a typical agricultural county: only 36 per cent. of the inhabitants live in urban districts, and 64 per cent. in rural districts; the density of population being only .37 persons per acre, viz., 5 per acre in the urban and 0.2 in the rural districts. In Durham, the chief industries have to do with coal, iron, and lead; 65 per cent. of the inhabitants live in urban as against 35 per cent. in rural districts, and the density of the population is 1.3 persons per acre, viz., 10 persons per acre in the urban and .52 in the rural districts. If it were not for the sparsely-populated moorland districts on the western border of the county, the density of the population of the rural districts would be greater still, for in the Durham coalfield the so-called rural districts contain many large aggregations of pitmen's cottages, which have sprung up with the development of the collieries, and unfortunately often without

much sanitary supervision. In Dorsetshire less probably has been done in the way of public sanitary work than in many other counties; but the scattered population, and the dry chalky soil on which much of the county stands, are favourable to health; and though wages are low, the habits of the cottagers as regards cleanliness and domestic economy would, I think, come out very favourably in comparison with those of the northern pitmen. The marriage-rate in Dorsetshire is low (13.7), in Durham higher (15.5), and marriage takes place earlier in the latter county, especially among women: in the ten years 1887-96, 13.6 per cent. of the women married in Dorset were under twenty-one years of age; in Durham 27.1 per cent., or double as many. In consequence, the birth-rate in Durham (36.1) is much higher than that in Dorset (26.7). The infant mortality, however, is also much greater in Durham: 161 out of 1000 infants born die within their first year, against only 97 in Dorset. The average annual death-rate in Dorset in 1887-96 was 15.8, in Durham, 19.2; but corrected for age and sex-distribution, the numbers become 13.9 in Dorset, and 20.1 in Durham: the age-constitution of the population in Dorset being older, in Durham younger, than that in the kingdom at large. As in the case of Lancashire compared with Surrey, the mortality in the mining county is higher than that in the agricultural county at all ages, except extreme old age.

TABLE XIV.—1887-96.

Average Annual Death-rate per 1000 of persons living at subjoined Ages—	0–	5–	10–	15–	20–	25–	35–	45–	55–	65–	75–	85+
Dorset ..	33.3	3.2	2.2	3.8	4.7	5.9	8.4	12.4	24.3	55.1	131.2	305.4
Durham ..	60.7	5.1	3.3	5.1	6.2	7.2	10.5	16.9	33.5	71.5	152.2	286.4

The infectious diseases of childhood—measles, scarlet fever, and whooping-cough—are much more fatal in Durham, causing annually in 1887-96 an aggregate mortality of 1.2 per 1000, against .49 in Dorset. This greater mortality in Durham is doubtless attributable largely to the greater number of persons living at the most susceptible ages, but other contributory causes may be found in the recklessness about infection characteristic of a rough mining population, and in the closer aggregation, facilitating spread of infection. The pitmen's houses are commonly in long rows, with a common yard at the back, which is the meeting-place for children of different families. Diphtheria was slightly more fatal in Dorset. Fever, mostly enteric, but with a

Divisions.	per 1,000 Population.					
	Diarrhœa.	Phthisis.	Cancer.	Influenza (1890-97).	Respiratory Diseases.	Circulatory Diseases.
I.	.61	1.50	.69	.32	3.55	1.67
	.67	1.86	.77	.31	4.05	1.56
II. S.E.	.33	1.36	.70	.38	2.41	1.58
	.43	1.35	.73	.31	2.66	1.64
	.35	1.45	.82	.39	2.51	1.69
	.42	1.61	.74	.35	2.71	1.75
	.34	1.23	.77	.40	2.61	1.83
III. S. Mid.	.56	1.18	.63	.32	2.65	1.28
	.36	1.28	.77	.41	2.57	1.98
	.32	1.11	.71	.45	2.71	1.71
	.32	1.19	.79	.37	2.66	1.89
	.48	1.24	.75	.46	2.74	1.59
	.31	1.31	1.11	.38	2.86	1.54
	.46	1.24	.77	.40	2.70	1.67
	.37	1.43	.92	.39	2.65	1.77
IV. N.E.	.56	1.23	.65	.34	2.97	1.43
	.39	1.41	.79	.38	2.73	1.73
	.48	1.27	.83	.42	2.60	1.74
V. S.W.	.25	1.19	.73	.52	2.97	2.15
	.24	1.18	.76	.40	2.71	2.01
	.36	1.50	.85	.38	3.36	1.98
	.39	1.48	.81	.32	3.13	1.80
	.28	1.16	.77	.35	3.03	2.04
VI. W. Mid.	.37	1.34	.77	.29	3.22	1.95
	.23	1.18	.86	.68	3.01	2.33
	.30	1.21	.84	.55	2.83	2.17
	.81	1.19	.56	.27	4.11	1.45
	.53	1.09	.65	.30	3.08	1.69
	.88	1.48	.71	.30	3.89	1.68
VII. N. Mid.	1.01	1.17	.65	.24	3.00	1.54
	.20	1.08	.88	.46	2.33	1.72
	.52	1.29	.78	.41	2.74	1.75
	.75	1.71	.65	.28	3.26	1.58
	.55	1.24	.55	.36	3.27	1.67
VIII. N.W.	.58	1.41	.64	.29	3.55	1.73
	.92	1.70	.57	.25	4.91	1.67
IX. York.	.71	1.60	.62	.27	4.14	1.66
	.93	1.44	.71	.37	3.36	1.72
	.50	1.26	.66	.35	3.27	1.74
X. N.	.78	1.53	.53	.19	3.59	1.49
	.60	1.89	.67	.23	2.97	1.83
	.34	1.33	.69	.34	3.15	1.90
	.22	1.09	.74	.47	2.29	1.92
XI. Wales.	.38	1.17	.54	.43	4.19	1.65
	.47	1.69	.60	.29	3.69	1.60
	.24	1.80	.89	.47	3.26	1.99

small proportion of typhus, was 3½ times as fatal in Durham as in Dorset — in fact, as before mentioned, Durham heads the list of English counties as regards prevalence of enteric fever. This is partly due to there having been in Durham, during the period 1887-96, several extensive epidemics of enteric fever, due to specific contamination of public water services; but there is also an endemic prevalence of enteric fever in Durham, for which the midden-privy system is probably responsible. This system prevails in an aggravated form in Durham, where it is the custom to allow the colliers a quantity of coal gratuitously, or as part of their wages. Hence ashpits are made of large size, and scavenging is a difficult matter. Open channels are often used instead of covered drains at the backs of pit rows, and these channels, if blocked by rubbish or frost, are apt to lead to the surface of the yards being fouled with sewage. Diarrhœa is fatal in Durham, causing a mortality of .78, as against .24 in Dorset. Its prevalence is probably due to much the same causes as that of enteric fever. Phthisis is more fatal in Durham than in Dorset, and diseases of the respiratory organs are much more so. On the other hand, diseases more fatal to persons at later periods of life, such as diseases of the organs of circulation, influenza and cancer, killed a larger proportion of persons in Dorset than in Durham.

Comparative Mortality of the Great Towns.

Time will not allow me to say much under this heading, and many of the points have already been incidentally mentioned.

In the ten years 1888-97, among the thirty-three great towns the average annual death-rate was lowest in Croydon (14.4), followed by West Ham, Portsmouth, and Derby (17.4), and Brighton (17.5). It was highest in the Lancashire towns, especially in Liverpool and Salford (25.5), Manchester and Preston (24.8). The effect of correction for age- and sex-distribution is to raise the death-rate in all the large towns except Norwich and Plymouth; that of Croydon becomes 15.0, while the death-rates of Liverpool, Manchester, and Salford become 28.0 and over (see Table XVI).

On a superficial view no relationship is apparent between the death-rate and the density of the population; indeed, the town with the greatest number of persons per acre (West Ham) has a lower death-rate than Huddersfield,

which has the smallest number. But the proportion of the population to the acreage of the whole town is no guide to the actual density in the inhabited parts, as some municipal boroughs include a wide tract of surrounding sparsely-populated country. Thus, the borough of Sheffield embraces a wide and almost uninhabited moorland region, extending to the borders of Derbyshire, and the density of population, reckoned upon the whole area of the borough, is only 18.1 persons per acre; yet in North Sheffield, the most populous registration sub-district, the density is 224 persons per acre. Moreover, in two towns which have an equal density of the population within the municipal area, other circumstances being similar, that town of which the boundary adjoins the open country will have a purer air than that town which is surrounded by a ring of other populous urban districts. It also makes much difference to the death-rate of a town whether the residential suburbs in which the well-to-do people live are within the municipal area or not, for this is the section of the inhabitants among whom the death-rate is the lowest. The unhealthiness of the central parts of a large town as compared with the suburbs is well illustrated in the case of London. During the ten years 1889-98, the average annual death-rate in the central districts of London has been 23.1; in the poor and crowded eastern districts, 22.7; in the western, northern and southern districts, containing most of the residential suburbs, 18.3; and in the outer ring 14.5. The density of population in 1891 in these groups of districts was: Central, 116 persons per acre; Eastern, 128; Western, 71; North, 74; South, 35; Outer Ring, 4.

I had hoped to find that the rateable value* of the buildings in a town divided by the population, would form some test of the relative affluence or poverty of the inhabitants,

* In urban districts certain classes of property, viz., arable land, meadows and pastures, woodlands, market gardens and nursery grounds, land covered with water, canals and railways, are assessed to the general district rate on a fourth part only of their annual value; houses and other buildings being assessed on their full value. A return issued by the Local Government Board in 1896 gives for each district the "rateable value," *i.e.*, the gross annual value and the "assessable value," *i.e.*, the net annual value when the above-mentioned classes of property are assessed at one-fourth only of their annual value. If, therefore, in any given district we subtract from the assessable value one-third of the difference between this and the rateable value, we arrive approximately at the annual value of the buildings in the district. The figures given in the sixth column of Table XVI are the quotients when the annual values thus obtained are divided by the populations of the several towns.

Death-Rates per 1,000 Inhabitants.

Corrected Age and Sex.	Measles.	Scarlet Fever.	Diphtheria.	Whooping Cough.	Fevers.	Diarrhœa.
21.0	.62	.23	.48	.56	.15	.67
18.7	.61	.24	.43	.55	.22	.76
15.0	.36	.07	.29	.39	.11	.47
17.7	.35	.07	.17	.33	.12	.66
17.8	.46	.09	.17	.33	.23	.82
20.0	.57	.48	.16	.44	.16	.64
19.2	.46	.15	.13	.45	.12	.50
21.3	.44	.21	.31	.47	.17	.82
20.8	.47	.57	.09	.45	.19	.36
23.0	.44	.25	.30	.47	.23	1.20
22.9	.51	.23	.21	.55	.16	1.11
18.2	.34	.10	.21	.45	.24	.87
20.0	.41	.19	.15	.39	.20	1.49
20.2	.41	.19	.08	.43	.29	.98
17.9	.34	.14	.13	.39	.20	.70
21.4	.54	.17	.19	.51	.32	.75
28.0	.70	.45	.17	.62	.35	1.17
25.5	.79	.31	.12	.63	.29	1.26
28.2	.80	.35	.26	.61	.26	1.10
28.7	.99	.47	.41	.75	.41	1.40
25.0	.71	.26	.16	.51	.16	.63
24.1	.65	.29	.22	.38	.26	1.29
25.4	.97	.34	.05	.50	.27	1.23
27.3	.92	.20	.13	.55	.33	2.05
21.3	.31	.23	.13	.36	.13	.30
21.8	.73	.15	.14	.28	.16	.25
22.4	.45	.24	.07	.43	.15	.87
23.1	.46	.20	.11	.43	.22	1.10
24.0	.49	.36	.16	.51	.23	1.21
20.8	.40	.17	.12	.37	.24	1.29
22.8	.59	.21	.08	.46	.49	1.12
21.1	.49	.21	.13	.43	.22	1.01
22.5	.57	.14	.20	.50	.15	.69

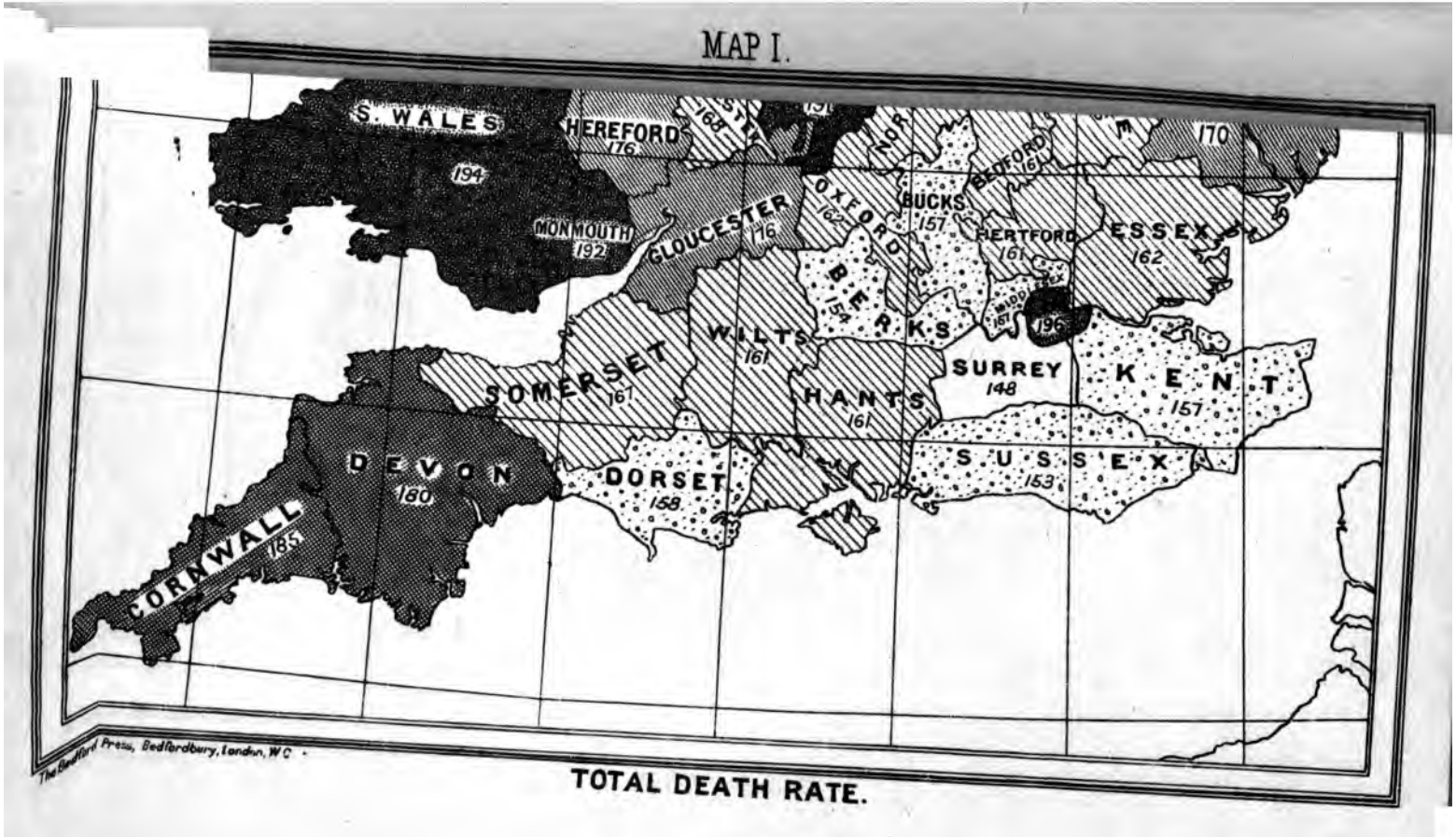
but I have not been able to make out any relation between this quotient and the death-rate. The rateable value per head is lowest in Hull, and next in Gateshead and Norwich. It is highest in Brighton, and next in Liverpool and Manchester. It is much greater in Manchester than in Salford, though their death-rates are about equally high.

Nor is it easy to establish a connection between the prevalence of overcrowding and a high death-rate. Taking as overcrowding a proportion of over two persons per room, among the great towns of England overcrowding is most frequent in Gateshead, and almost least so in Preston; the proportion also of persons per acre is somewhat less in Preston than in Gateshead; yet the corrected death-rate, 1888-97, in Gateshead was 21.1, and in Preston 27.3. There are, indeed, not a few instances in which considerable differences, not easy of explanation, are observed between the death-rates of towns apparently similarly circumstanced. Thus, for some reason not lying on the surface, the Lancashire towns are much more unhealthy than those of the West Riding. Bolton, Blackburn, and Burnley are not unlike Huddersfield and Halifax in many of their circumstances; yet the corrected death-rates in the three former towns are 3 or 4 per 1000 higher than those in the two latter, the difference being especially great in the mortality from diarrhœa. Again, it is not evident why Derby should have a death-rate some 2 per 1000 lower than its neighbours, Nottingham and Leicester; nor why Leicester should have a diarrhœal death-rate so much higher than Nottingham and Derby, and Nottingham an enteric fever death-rate higher than that of Leicester and Derby. Plymouth has a death-rate more than 2 per 1000 higher than Portsmouth.

Of course I do not mean that such circumstances as crowding of houses upon the ground, and of persons within houses, and poverty of the inhabitants, have no influence in raising the death-rate of a town; on the contrary, there is abundant reason for believing that these are among the conditions which most powerfully conduce to a high mortality. I only mean that the data for the several large towns are so little comparable one with another, and individual towns are so little homogeneous in the different parts of their area, that this influence is not demonstrable when the town itself is taken as the unit: in order to demonstrate the relation, it is necessary to carry the investigation into smaller areas, and compare the several quarters of a single town one with another.

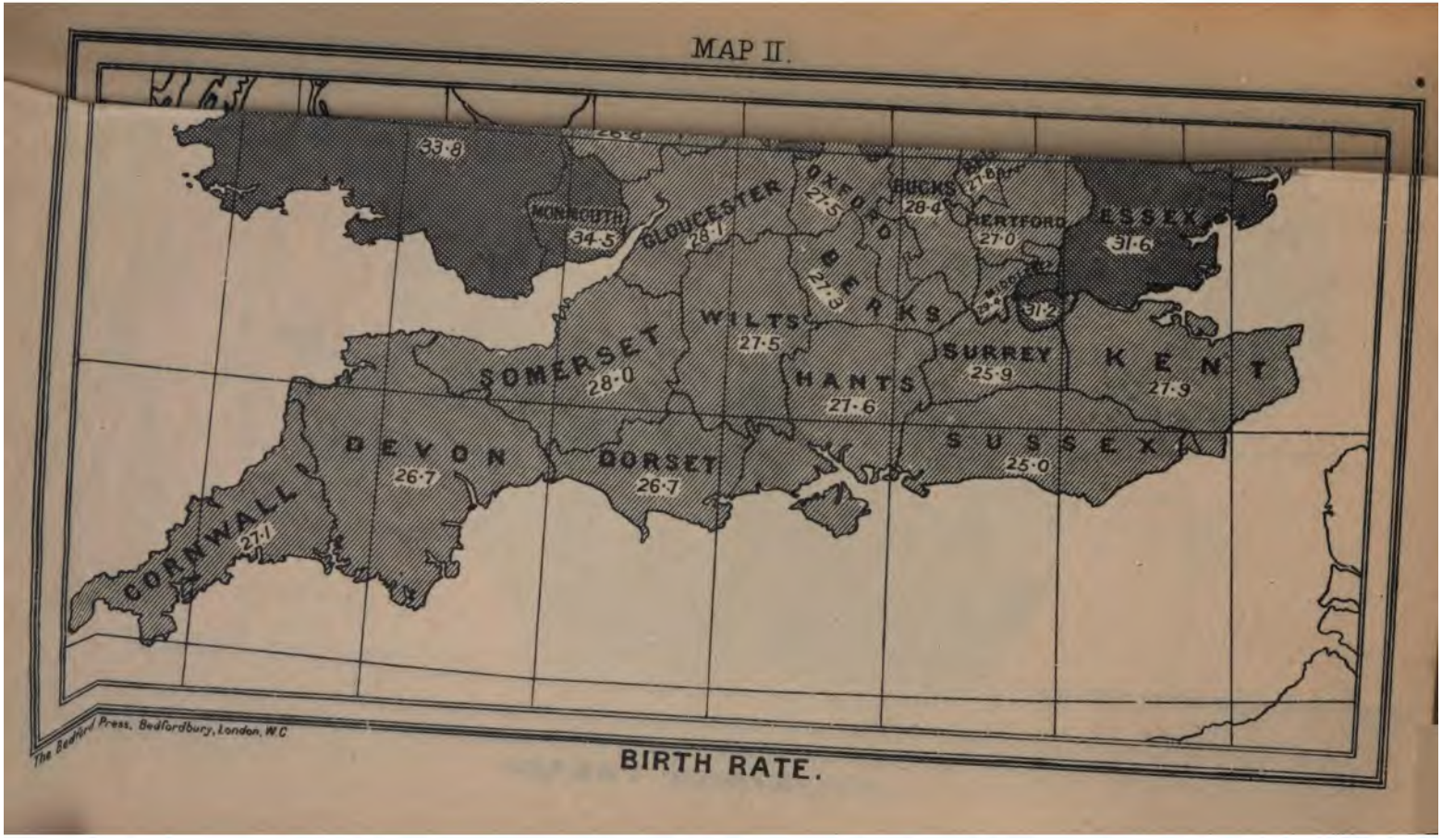
We may, I think, say that the healthiest towns are those of rapid modern growth, the development of which has taken place under proper regulation, and which have been sewered from the first, so that the bulk of the houses are built on clean soil which has never been polluted by soakage from privies and cesspools, and have about them a proper amount of open space. In most of the healthier towns the amount of open space about houses is regulated by bye-laws, on the model issued by the Local Government Board; that is to say, each newly-erected house is required to have in front of it an open space not less than 24 ft. across, and behind it an open space exclusively belonging to it of not less, in any case, than 150 square feet in area and 10 ft. across, a greater distance across being required as the height of the building increases. In some towns, indeed, as Croydon and Cardiff, still larger amounts of open space are required. On the other hand, in most of the less healthy towns, the amount of space about houses is regulated by local Acts and obsolete bye-laws, and is less than the standard of the model bye-laws. I think it likely that the prevailing arrangement of the houses upon the ground—*e.g.*, whether they are in regularly laid-out streets or in enclosed courts or narrow alleys—has much to do with the different rates of mortality in different towns. The prevalent method of excrement disposal and removal is doubtless a potent factor. The social circumstances and psychological habits of the population are, perhaps, a still more powerful one. When I commenced writing this address, I had intended to seek for information on these and other points, in the hope that I might be able to arrive at some more original and definite deductions than I have been able to place before you, but pressure of other duties has not permitted this; and, as it is, I have trespassed long enough on your time and attention.

MAP I.



TOTAL DEATH RATE.

MAP II.



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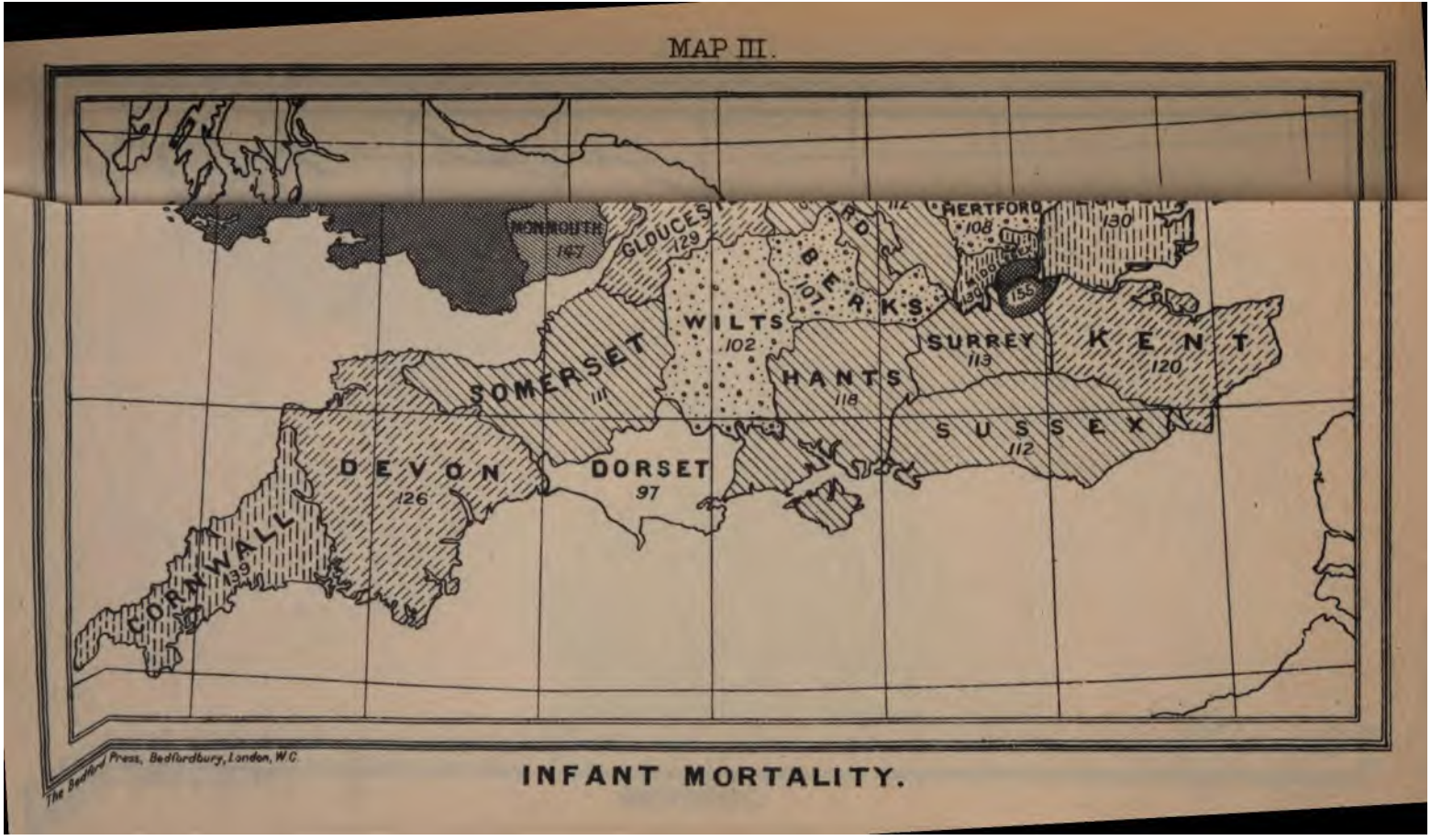
BIRTH RATE.

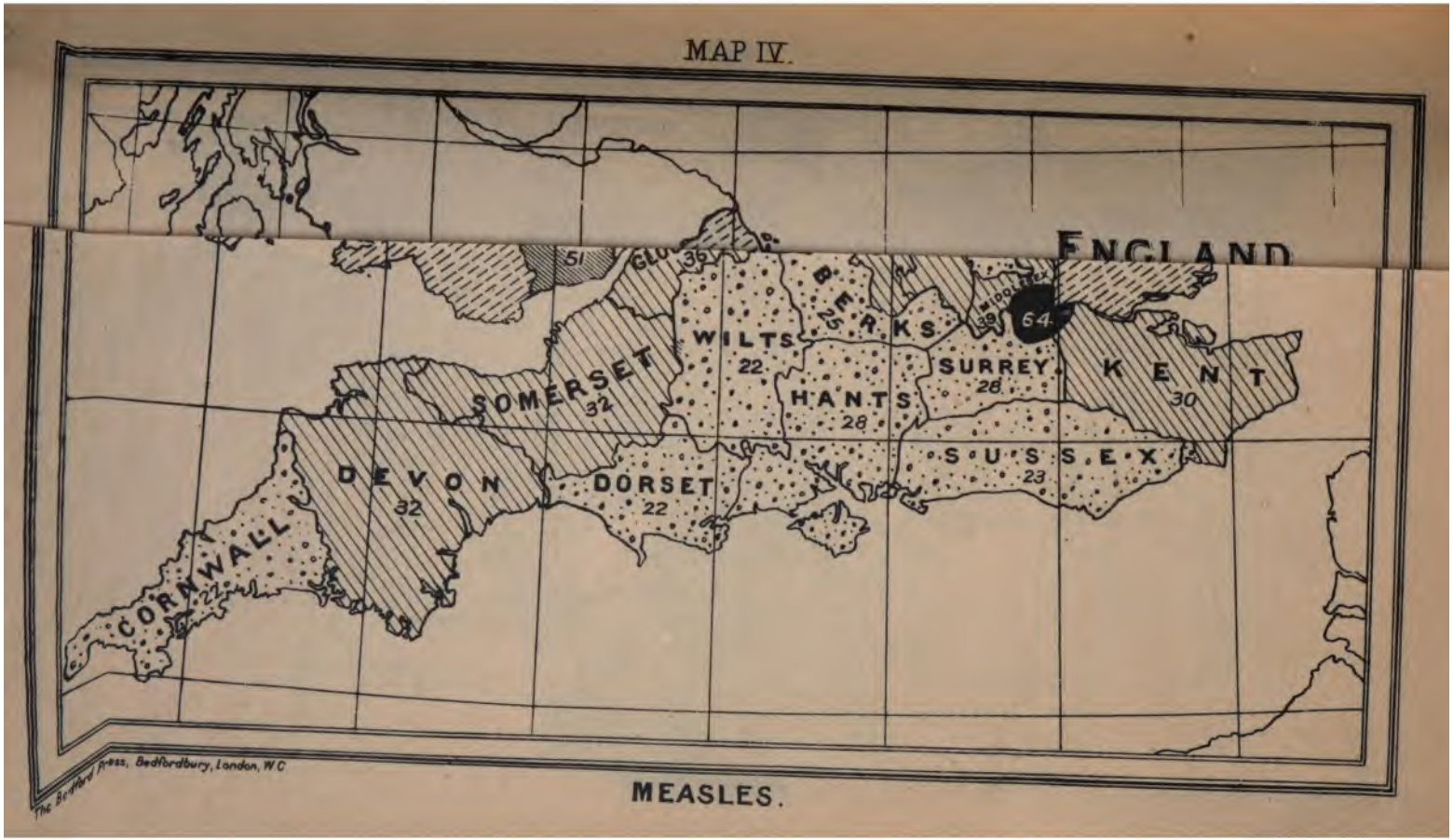
MAP III.



INFANT MORTALITY.

ENGLAND
WALES
IRELAND
SCOTLAND

MAP IV.



MEASLES.

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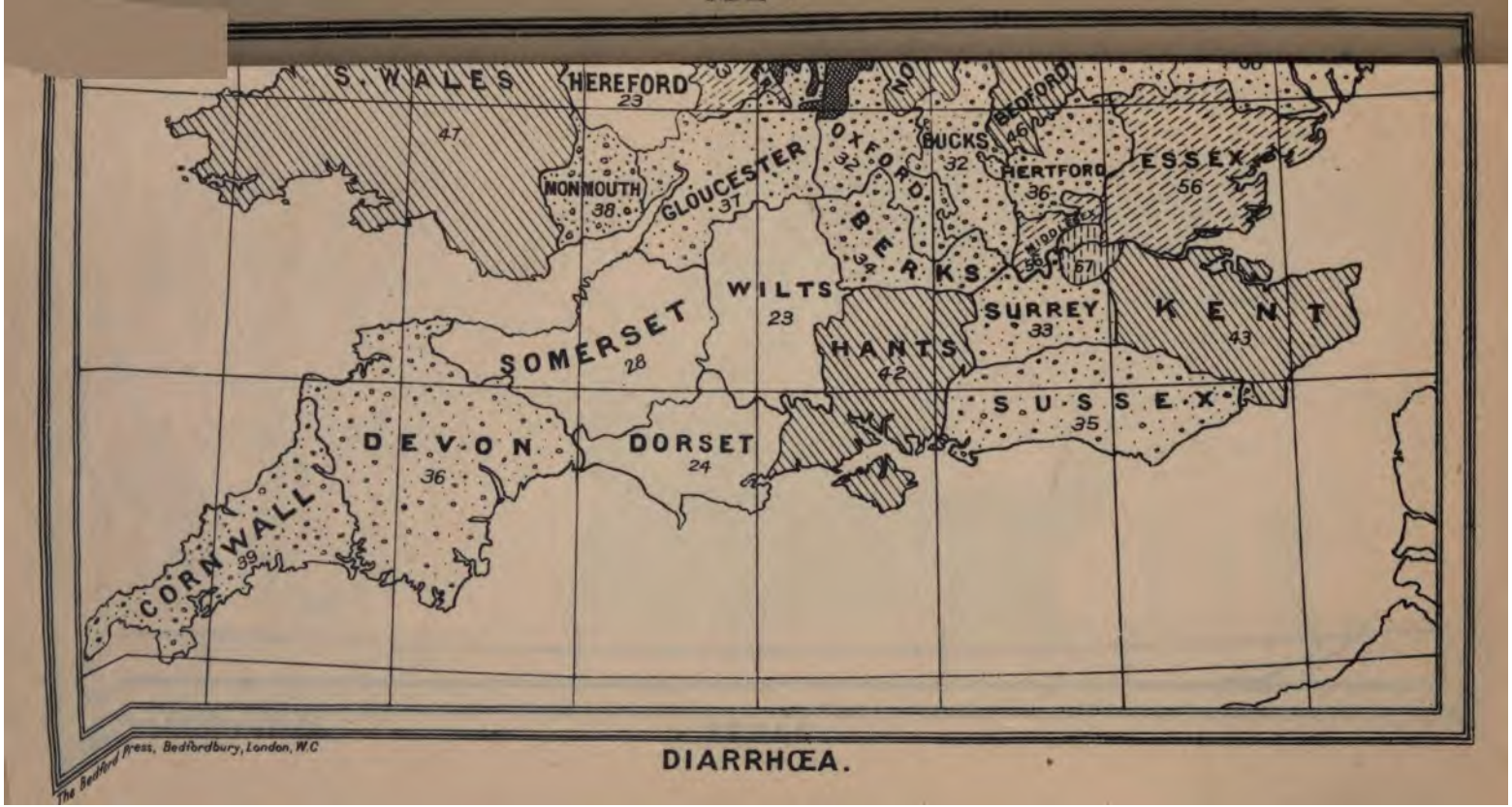
ENGLAND
WALES

MAP V.



DIARRHŒA.

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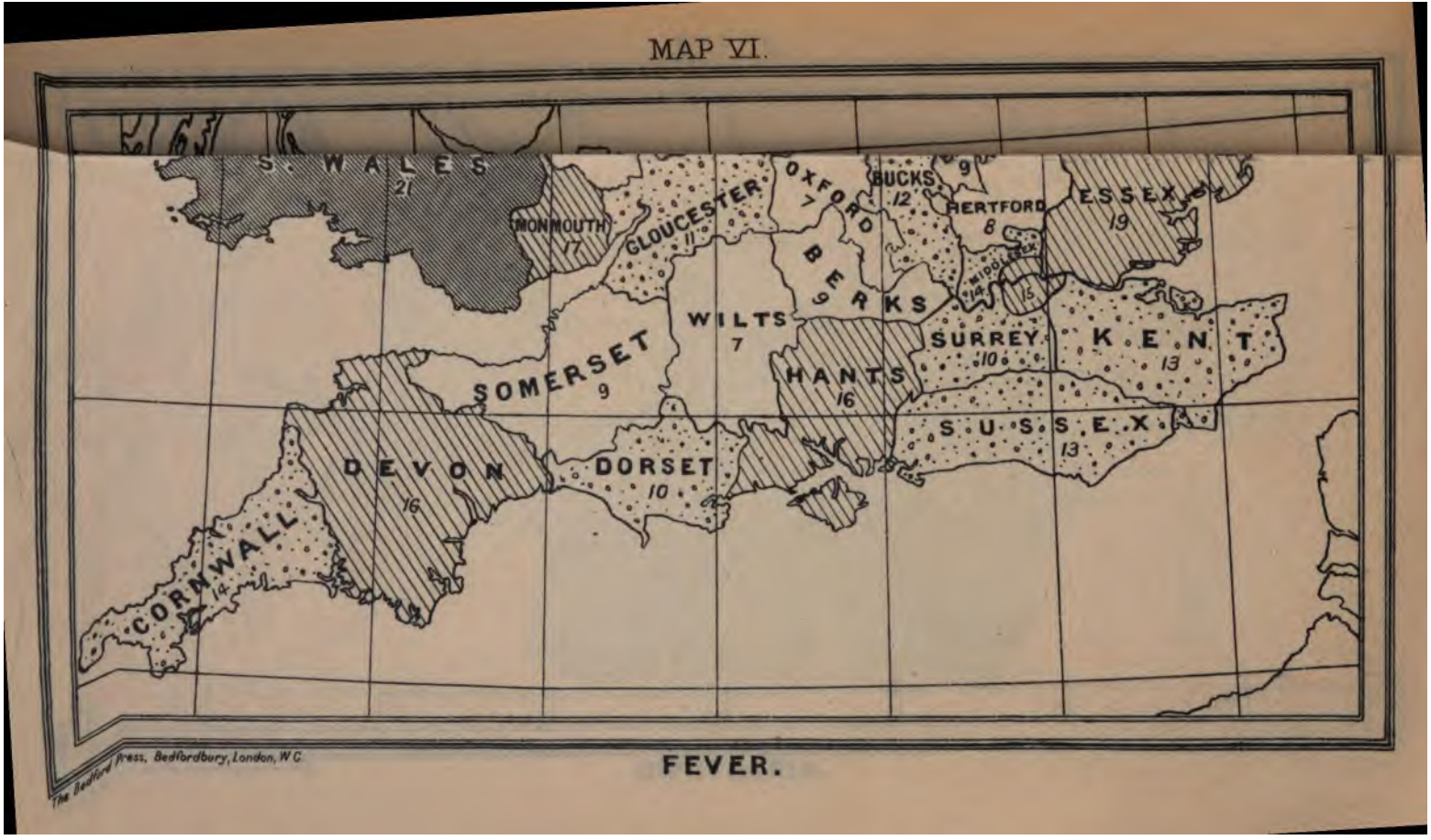
MAP VI.



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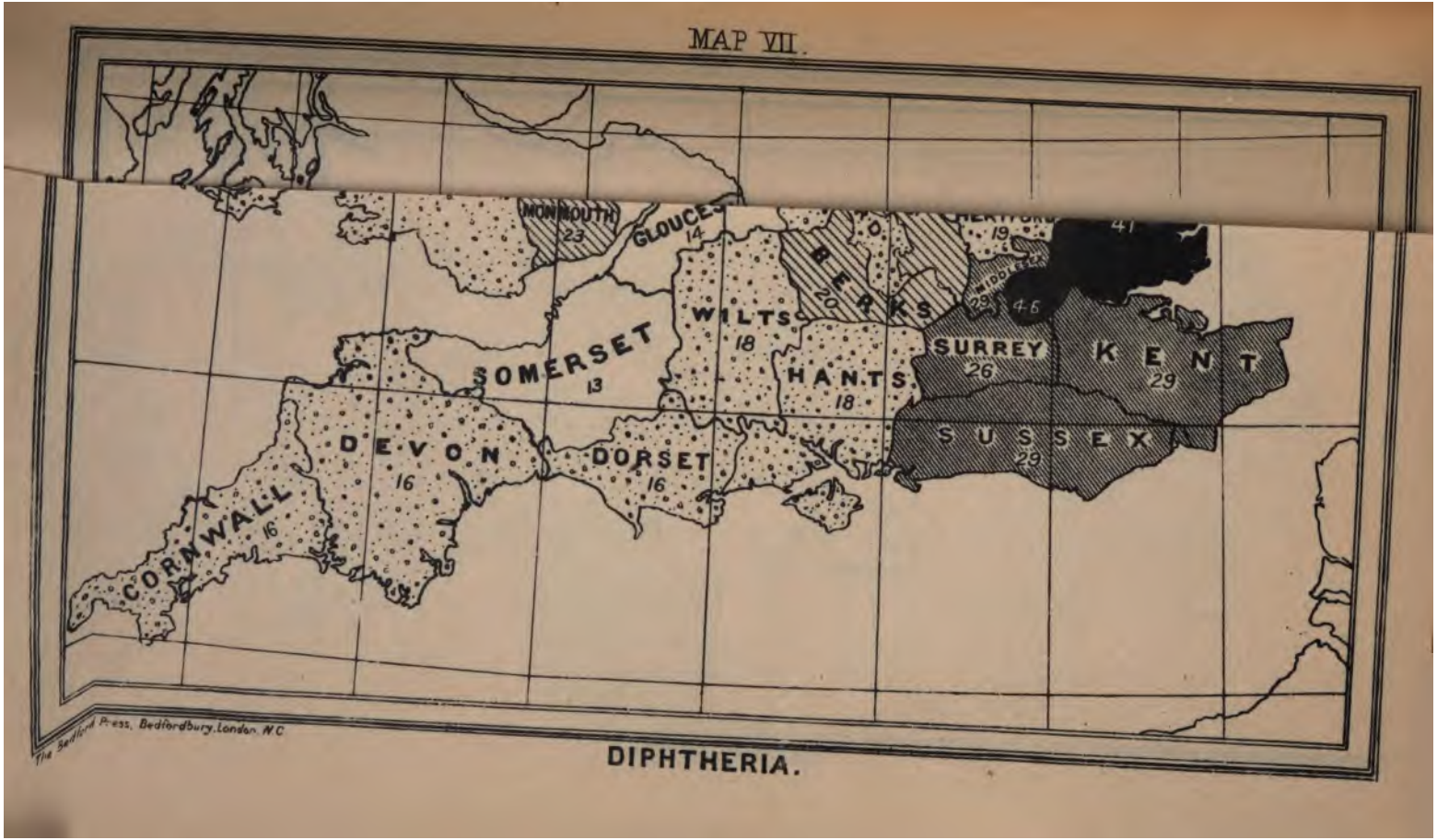
FEVER.

MAP VII.



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DIPHTHERIA.

MAP VIII.

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INFLUENZA.

MEASURES TAKEN AT TOR AND SUEZ AGAINST SHIPS COMING FROM THE RED SEA AND THE FAR EAST.

By MARC ARMAND RUFFER, President of the Sanitary, Maritime, and Quarantine Board of Egypt.

(*Read: December 15th,* 1899.)

Mr. President and Gentlemen,—In the first place, I wish to express my thanks to you for the honour you have done me in asking me to read a paper before your Society to-night. I greatly regret that, owing to the impossibility of getting leave, I shall not be able to read the paper myself, nor answer any questions. I can only say, that if any member wishes to have further information with regard to any point raised in this paper, I shall be happy to answer his questions by letter, if he will communicate with me.

I must begin this paper by describing the present state of the sanitary services in Egypt, for it might appear somewhat strange that I criticise regulations which it is my duty to enforce; but, as will be seen, the regulations are not of my own making.

Egypt is the happy possessor of two sanitary services. The first looks after the sanitation of the whole of Egypt, and forms one of the departments of the Ministry of the Interior. The second is under the Sanitary, Maritime, and Quarantine Council of Egypt; and on this Council, England, Turkey, Spain, Sweden and Norway, Portugal, Belgium, France, Austria, Germany, Denmark, Russia, Greece, Holland and Italy, are each represented by one delegate, who may or may not have the assistance of a medical adviser. Egypt is represented by the President, the Inspector-General, the Chief Veterinary Inspector of the Sanitary Service, and the Sanitary Inspector of the town of Alexandria. Every one of the nations represented has one vote, whereas Egypt has three. The President, however, has only a casting-vote, in case of an equal division of the other votes.

All the members of the Board, the President and the Veterinary Inspector excepted, must either be duly qualified medical men, or have the rank of vice-consuls, and duly belong to the professional Consular Service.

The President has no control over the Council, nor over the finances and staff, except what his personal influence gives him. He presides at the meetings and executes the decisions of the Council, but he can neither appoint nor dismiss any official, nor punish him in any way except by permission of the Council. He is not allowed to spend one sou without the leave of a special committee on finance, nor can he make any reform, be it ever so urgent, without the approval of the Council.

I take this opportunity of stating that the medical men who are members of the Council have always, at any rate during my term of office, worked with zeal and singular fairness, looking at most questions from a professional point of view. The presence of the Consular element on the Board is altogether an anomaly, and in my opinion these gentlemen should have no voice in decisions concerning technical points. It is little short of ridiculous to allow men without technical knowledge to interfere in such questions.

The decisions of the Council must be in accordance with the decisions of the Convention of Venice; and, indeed, the tendency of late years has been for the Council to apply such measures only as are clearly laid down by that Conference. Whether these measures are altogether satisfactory or logical, whether they accord with the latest ideas regarding the progress of infectious disease, whether they are not rather a halting compromise between the opinion of the extreme quarantinist, and that of the pushing shipping-agent who would infect the whole of Europe rather than consent to his ship being delayed ten minutes, are questions which need not concern us at present. I would point out, however, that the united wisdom of Europe sitting at Venice has produced a set of regulations in which the same paragraph orders two contradictory measures to be carried out.

The point which is of interest this evening are the measures which are taken to prevent ships coming from the Red Sea and Far East from carrying plague and cholera into Egypt and Europe. The very existence of such regulations shows that Europe tacitly acknowledges that it is possible to prevent the entrance of cholera and plague into any country by quarantine measures. But,

as is well known, in spite of such measures cholera and plague have passed into Egypt, and through the Suez Canal into Europe.

The measures vary according to whether the ships carry pilgrims or ordinary passengers. The ships carrying pilgrims from the Hedjaz are not allowed to go through the Canal, or to land Egyptian pilgrims into Egypt, until ship and passengers have undergone a period of observation at Tor.

The pilgrimage, or Hadj, is a yearly occurrence, and consists in the visit which all good Mahometans are expected to pay, once at least in their lives, to the Caaba at Mecca, and to the tomb of their Prophet at Medina. It is attended by Mahometans from Europe, Asia and Africa. Formerly large camel caravans left every year for Mecca and Medina. Others went to Jeddah in small boats, and the danger of the pilgrims bringing back plague or cholera was minimised by the long sea or desert journey. Since the introduction of railways and steamers, however, conditions have changed ; and, were it not for quarantine regulations, an Egyptian pilgrim might go from Egypt to Mecca and return to Suez in little more than a fortnight. The number of pilgrims who pass annually through the quarantine camp of Tor varies from 12,000 to 30,000.

The most sacred spot on earth to a Mussulman is the Mosque at Mecca, which encloses the Caaba : a black stone which marks the spot where Adam first worshipped on his expulsion from Paradise. It is said to have been placed there by Abraham and Ishmael. Certain it is that it has existed on the spot from time immemorial, and served before Mahomet's time for the rites of some idolatrous tribes in the neighbourhood. Since the second year of the Hegira, it has been the point to which all followers of the Prophet are expected to turn when at their devotions. Mahomet ordained that it should be visited every year, on the 10th of the month, which he fixed as the anniversary of the sacrifice of Isaac, and his release at the command of the angel.

The second object of the pilgrimage, namely, the visit to Mahomet's tomb at Medina, may be accomplished either before or after this date.

As far as El Tor is concerned, the pilgrims coming from Mecca are divided into two main bodies, which arrive at the quarantine station at an interval of four or five weeks.

The first lot comprises the Turks, Algerians, Maroccans, as well as Herzegovinians, Servians and Bulgarians, and a

goodly number of people from Asia Minor, the Caucasus, Turkestan, and even far-off Mongolia. A picturesque and motley crew they are, showing features and dresses collected from an area of some 4000 miles in length, and embracing stragglers from three continents, all fired with the same religious zeal and bent on the same errand.

The second division of the pilgrimage shows less variety of nationality and costume, as it consists only of Egyptians and their immediate neighbours, the Soudanese, Syrians, etc. These generally visit Mecca first, and afterwards Medina, from whence they travel to Yambo, where pilgrim ships are supposed to await them to bring them up the Red Sea. The Turks, on the other hand, invariably visit the tomb of the Prophet first, then the Caaba at Mecca, and leave Djeddah for Tor some weeks before the Egyptians reach Yambo.

The means of transport of these thousands of devotees is totally inadequate, the overcrowding, want of sanitary arrangements, filth and distress of the people, resembling exactly the horrors of the slave-ships of the eighteenth century. Indeed, to those who have been eye-witnesses of the facts, it is incredible that such a state of things can be tolerated; and it does not redound to the credit of Christianity to know that the shipowners who are responsible for such mismanagement are practically all Christians. Each ship is licensed to carry a limited number of passengers at so much a head, but many shipowners make an illegal profit by embarking nearly double the number of passengers allowed by the licence. Of course, the poor wretches who are congregated by thousands at the port will gladly pay full fare to be taken off at once, even if there is only standing-room on the ship; for, after the hardships they have undergone of travel, insufficient food, robbery by Bedouins, etc., their one thought is to reach home at any cost. Consequently, many of the ships, though licensed to carry a certain number of passengers, arrive at Tor with double that number, and the wretched pilgrims are literally crowded like sardines in a tin, there being barely room to lie down on the deck. The scenes of confusion and filth, with the horrors of sea-sickness and other forms of malady, almost defy description.

On one occasion, the writer saw a steamer arrive with a crowd of some thirty women packed together outside the paddle-boxes, a mere flimsy wooden barrier being the only obstacle to prevent them falling overboard; had they met with a rough sea, the whole lot must have been washed over.

The sanitary arrangements often consist merely of large packing-cases slung over the ship's side, and with a hole cut through the bottom. As a rule, however, the crowding is so intense, that it is quite impossible for the pilgrims to reach even these primitive arrangements: and as quite 50 per cent. of the people suffer from diarrhœa, they relieve themselves anywhere, as best they may. The overcrowding is so great that it is not uncommon to find dead people covered with fæces and urine lying in the midst of their fellows.

Let it be said at once that the few steamers belonging to the Austrian lines which carry on this traffic are a brilliant exception. The Austrian Government has imposed such heavy penalties on their captains for overcrowding, etc., that their ships are almost perfect from a sanitary point of view. There is some hope that some remedy will be found shortly for the state of things on other boats.

Each pilgrim ship carries a medical man; but even should he wish to do so, he is quite unable to do anything, and we fear that, too often, he aids and abets the owners in their infamous traffic.

For instance, when a death occurs on the way, one knows that frequently the body is thrown overboard and the death stoutly denied. When the death occurs in or near the harbour, the captain resorts to the quaintest expedients to hide the corpse, such as hanging it over the side of the ship, etc. It is a peculiar fact, that, although most of the doctors stoutly deny that any deaths have taken place between Jeddah and Tor, two or three pilgrims invariably die within a few hours of their arrival at Tor.

The captain takes as many passengers as he can possibly get on board. In most cases, he apparently makes a guess as to the number of people, and enters a certain number on the bill of lading. But this number is invariably wrong, as the Table on page 30 will show.

It stands to reason that neither shipowners nor quarantine officials can estimate how much money the ship's captain or agent has actually received, nor how many people have died on the passage.

One word in favour of the Mussulman pilgrim may not be out of season, for he is a person who, in my opinion, has been much maligned. My experience of him extends over a period of three years, and I confess to a feeling of great respect and liking for the unfortunate person. Treat him well, and above all, give him plenty of water, and the

supposed fanatic becomes the most docile, easy-going, grateful, and polite Eastern gentleman. A friendly nod to a group of these people sitting before their tents, will cause the whole lot to rise and salaam with a stately grace and politeness which is not to be found outside the East. Their so-called fanaticism is too often the feeling of bitter resentment for the ill-treatment which they have received from the Christian scoundrels in whose hands the pilgrim trade has been up to now.

The port and village of Tor are situated about 120

Year 1898.

Nationality of Ship.	Number of Pilgrims on Ship's Books.	Number actually found.
Turkish	551	667
English	550	627
Turkish	1041	1137
Egyptian ...	844	926
Greek	700	810
English	695	756
„	1022	1175
Egyptian ...	530	599
Turkish	987	1181
„	1175	1506
Egyptian ...	420	607
English	350	390
Egyptian ...	713	790
Turkish	1220	1738
English	579	731
Egyptian ...	549	635
Greek	664	698
Turkish	1000	1013
Egyptian ...	5	5
Turkish	700	924
Egyptian ...	37	37
——	14,332	16,952

miles south of Suez, in the Sinaitic peninsula at the foot of Mount Sinai. One might almost think Tor had been designed for a quarantine station, as, owing to its geographical features, approach is practically impossible except by sea.

At the base of Mount Sinai lies a plain, some twelve miles wide and some ten miles long. At the northern end of this plain is the little town of Tor, founded (it is said) by the Empress Helena when she built the monastery on the mountain. The descendants of the original Greek

inhabitants still form the greater part of the population of the place, and carry on the work for which it was built, namely, of supplying the monks with fish, fruit, and other necessaries. Up till recently, they made great profit out of the wrecks which frequently occurred along this dangerous coast.

There are a few fresh springs around the town, and near these are groves of palms, figs, vines, etc. Over the rest of the plain, though water is easily obtainable, it is brackish, and the vegetation is very sparse, serving only to feed the goats of the few natives who eke out a scanty living in this lonely region. Though only about 120 miles from Suez by land, the absence of fresh water makes the land journey from Tor impracticable, except for a camel caravan or a hardy Bedouin. It is therefore useless for any pilgrim once landed at Tor to attempt to escape on foot; and, to add to the security of the camp, Bedouin outposts are stationed round, whose duty it is to bring back anyone found wandering about.

Even the approach by sea is not altogether easy, as the little harbour only affords shelter to small launches and fishing-boats. All large steamers have to anchor some distance from the shore, and if any unwary pilgrim were to escape and attempt to swim back to the ship, he would run a fair chance of being caught on the way by a shark. In addition to the natural security of its position, Tor seems specially fitted for a health camp by its climate. Though in the proverbially unpleasant Red Sea, it gets the full benefit of the north wind, which for three hundred days in the year blows down the Gulf of Suez. Even at Midsummer, this refreshing wind makes the heat of the sun tolerable. It is a rugged but very picturesque spot; the little white town stands out brightly against the blue sea and sky; the tents of the camp and the clumps of palm trees make a pretty foreground; while the bare lofty peaks of Mount Sinai, towering in the background, and the range on the western side of the Gulf, present all day an endless variety of colours, from pale misty blue at mid-day to deep pink and purple at sunset.

Within the last few years, and thanks to the liberality of the Egyptian Government, the former primitive arrangements have been considerably altered. Three separate landing-stages have been erected, leading to three separate disinfecting establishments; pipe-water has been laid down throughout the camp; a railway has been built for the conveyance of luggage and the sick; and by next year a

bacteriological laboratory, post-mortem room, and—I trust—hospitals, will be built.

The pilgrims land in small boats on a jetty, along which rails have been laid, and take their luggage in trucks to the disinfecting station. This lies close to the sea at the head of the jetty, and the pilgrims wait in a great covered shed outside until their turn comes to enter the camp.

The camp lies a quarter of a mile away, and a little railway now takes the heavy baggage and the invalids. This camp is divided into compartments of about 150 metres broad, and 250 metres long, by fences of wire netting 10 ft. high; the compartments are now about thirty-six in number, and each can hold 500 people easily. They are not, however, occupied in succession, but an interval of two empty plots is always left between two lots of pilgrims. Thus, sections 1, 4, 7, 10 and 13 are in use together; so that in the event of a man trying to join friends in another section, has to climb four fences each 3 metres high, and is sure to be seen running across the intervening spaces. Moreover, in case of plague or cholera breaking out in section 1, all the inhabitants can be moved bodily into section 2, and there still will be two wire fences and a distance of 150 metres between them and the next lot of pilgrims.

At the entrance to each station there is a picket of soldiers, and each lot of 500 pilgrims has its complement of one doctor in charge, two supervisors, and a number of quarantine guardians, sweepers, etc., as well as its own little café, where the pilgrims may buy their food and a few little luxuries. The catering for the whole camp is undertaken every year by one contractor, who competes for this privilege with others of his trade, and the preference given to the man who can undertake to produce at the lowest rate food of a given quantity, and sufficient for a given number of people, for a stated number of weeks. Of course, there is a certain amount of grumbling; but the tea, coffee, bread, etc., sold by these caterers, is really of very fair quality. Each day, rations are served out at the expense of the Egyptian Government to the very poor pilgrims who cannot afford to purchase food. A great difficulty is to supply such a large number as 4000 to 6000 people with sufficient water, not only for drinking, but also for the ablutions imposed on them by their religion before morning and evening prayers. It must be mentioned that Tor is in the desert, and that there is only one well containing sweet water. This difficulty has been recently met by a pumping-

station, worked by steam instead of by hand. The water is pumped into a reservoir at the top of a hill, from which pipes run into all the sections, hospitals, etc.

Now that the well has been improved, the water is quite clear and sparkling, but with a very slight saline taste.

The hospitals up to date are primitive, consisting only of tents and a dispensary, one of the few wooden buildings to be seen in Tor camp; however, there are hopes that more permanent hospitals will shortly be provided.

The tents forming the hospitals are divided into four groups, each group being separated from the other by a large intervening space, and having a staff of its own. The hospitals are as follows:—

1. Hospital for ordinary diseases.
2. „ „ gastro-enteric diseases.
3. „ „ cholera.
4. „ „ plague.

Of these the hospital for gastro-enteric diseases is by far the most important, for the number of pilgrims who suffer from dysentery is enormous. Hardly a day passes but that three or four worn-out old men die from dysentery, or its complications. Liver abscesses, secondary pyæmia, intestinal perforations, are of frequent occurrence. Typhoid, small-pox, syphilis, all kinds of strange skin affections, occur among the contagious diseases; and indeed the camp at Tor is an immense field for pathological research. Besides these cases, we get every year a few cases of gun-shot wounds, in pilgrims who have been attacked by the wild Bedouin tribes of the Hedjaz.

We may now proceed to examine the international regulations which govern the pilgrimage.

The regulations are different, according as to whether the pilgrimage is clean or infected. If the pilgrimage is "clean," that is to say, if neither plague nor cholera are raging in the Hedjaz, the pilgrims are detained at Tor for three or four days, and the vessels which bring them undergo the same period of observation. Only those Egyptian pilgrims, or pilgrims residing in Egypt who are furnished with a card stating their place of residence, are allowed to land at Suez after a favourable medical visit. Foreign pilgrims may on no account land in Egypt, but must return in quarantine through the Canal, to their own countries. The transshipment of pilgrims in Egypt is at all times interdicted.

It will be noted that nothing is done when the pilgrimage

is "clean," except a period of observation. The authorities which decide whether the pilgrimage is "clean" or infected are the Turkish authorities at Jeddah, Mecca, and Yambo; and it stands to reason that the period of observation of three days is only enforced because the Powers who have signed the Convention of Venice have little confidence in the declarations of the sanitary authorities in the Hedjaz.

Indeed, this want of confidence is quite justified: for, during my term of office, at any rate, the authorities have never declared the presence of plague at Hedjaz, until the subject had become a matter of public notoriety through other sources.

If then the Powers rightly refuse to accept the declaration of the Turkish authorities, the logical deduction is that all pilgrimages should be considered infected until the pilgrims had been landed at Tor and found to be healthy. The operations of disinfection should be started at once, so that all infectious material should be destroyed, except that carried in the body of the person actually incubating plague or cholera. At present, the Convention of Venice does not allow of any precautions to be taken until the disease has broken out. They say: "We suspect these people to have plague or cholera material with them, but don't you do anything until you have given the cholera and plague bacillus a chance." The consequence is that a pilgrim might inoculate himself from plague or cholera-infected clothing after leaving Tor, and carry plague or cholera into Europe. I do not say that such a case has happened, but, judging from the experience of plague in India, where people contracted plague long after leaving India, such an occurrence is only too likely. Similarly, the vessels and crew of the ship are not disinfected.

The regulations with regard to foreign pilgrims not landing in Egypt are excellent, but most difficult to apply. However, they have been applied in their entirety during the last two seasons.

If the Hedjaz is infected with plague, all the pilgrims are subjected at Tor to a quarantine of twelve days, beginning only after the disinfection is quite finished.

Should there be an epidemic of cholera in the Hedjaz, the quarantine lasts for fifteen days after disinfection. The ships carrying pilgrims other than Egyptians then cross the canal in quarantine, and return to their respective countries; while those with Egyptian passengers proceed to Ras Abouzoulima, and undergo a supplementary obser-

vation of three days. The latter are then received at Suez in free *pratique* after another medical visit.

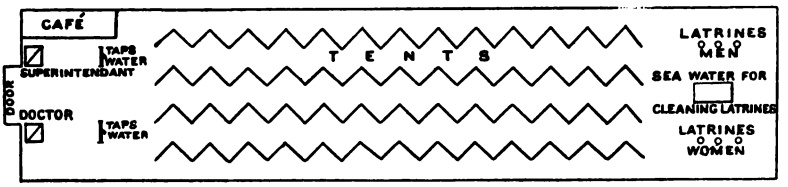
The regulations appear simple enough, and would indeed be so, were it not that one had to deal with an enormous mass of people arriving by batches of 500 to 1000 at a time. I have been not a little astonished by the ease with which gentlemen sitting comfortably in Venice, and elsewhere, order the disinfection of hundreds and thousands of individuals. As a matter of fact, no measure is more difficult to carry out successfully on a large scale.

The ordinary pilgrim coming from Egypt and the North is in many instances a trader, who combines religion with business, and brings back with him a large amount of goods to be sold in his own country. Ten or twelve boxes may form the luggage of such a man, and I have seen one pilgrim with no less than eighty boxes of luggage. Most of these goods are not such as would easily carry infection, but still the boxes have to be searched, and the dirty linen, &c., extracted.

The pilgrims are landed in batches of forty and taken to the disinfecting establishment, where their luggage is searched and all the things requiring disinfection removed. Linen, bedding, etc., is steamed at 110° Cent. for twenty minutes, the maximum temperature being ascertained by an electric-signal thermometer and a maximum thermometer. Shoes, slippers, etc., are put for five minutes to half an hour in a 1-in-1000 solution of perchloride of mercury. All water-skins are removed, and a tin-can closed by a cork is provided instead. While the disinfection is in progress and the goods removed to the clean side of the building, the pilgrim is taken to another room, where he takes off all his clothing and is provided with a clean shirt. He then undergoes a physical examination by a medical man. This consists of (1) feeling of the pulse; (2) examination of all the superficial glands; (3) examination of the tongue. If there is any sign of fever the temperature is taken, and the patient, if necessary, placed in an isolated hut at a distance of half a mile from the section.

Those who show no signs of disease are taken to be douched or bathed in warm sea-water, a process which appears to give them great satisfaction. The shirt they wore is removed, their clothing (which has been disinfected in the meanwhile) is restored to them, and they are at once marched off with their luggage to the camp, where six pilgrims sleep in each tent.

The following diagram illustrates the arrangement of a section.



The latrines have the usual Oriental seat, and sea-water is provided for the ordinary ablutions after defæcation. In each section two sweepers see to the disinfection of latrines.

As the pilgrim enters the camp his name is taken, and every morning the doctor in charge of the section is bound to hold a roll-call, to see and examine every pilgrim. The women, who are but few in number, are examined by a lady-doctor.

The rule is, that in case of cholera or plague breaking out, the inhabitants of each section shall be removed into the neighbouring empty space, after complete disinfection of all their goods and effects. The persons in contact with the patients, that is, sleeping in the same tent, are especially watched and examined night and morning. Luckily, such a case has not presented itself during the last three years.

After the period of quarantine is over, the pilgrims leave and go in quarantine through the Suez Canal to their respective homes.

The Egyptian pilgrims are landed again at Ras Abou Zuneima, a dreadfully hot, close, and stuffy place, a perfect hell upon earth, half-way between Suez and Tor, where they undergo another quarantine period of three days. The reason for this extra precaution is not obvious, and I am strongly of opinion that this measure should be suppressed at the earliest opportunity. In order to judge of the value of these measures against plague and cholera, it is necessary to give an outline of the way in which patients suffering from these diseases carry infection.

In plague, it appears pretty clear that the ordinary mild bubonic case is not infectious in himself, as the bacillus, except in rare cases, does not leave the body in the excreta of a mild case. A really bad and infectious case of plague is always so ill, that few medical men would fail to recognise the serious nature of the disease, and stop him

from embarking. A person who has got over plague is, in all probability, not infectious. At any rate, I know of no case in which a case of plague has been traced to a patient who has left the hospital cured. The length of the convalescence also would keep a patient in hospital so long, that, by the time he left he would be harmless. As the incubation period of plague does not exceed five days, it follows that, provided the rules concerning disinfection are well carried out, provided also convalescent patients are kept long enough to guard against a relapse, the measures taken now are sufficient to prevent plague being carried by the pilgrims.

With regard to cholera, the case is quite different. We know now that the vibrio choleræ persists, not unfrequently for as long as fifty or more days, in the evacuations of patients who have had cholera. We also know that, during an epidemic of cholera, the vibrio choleræ does appear in the stools of persons who at most suffer from slight malaise or diarrhœa; so that the clinical diagnosis of cholera becomes almost impossible in these cases. The only possible way in which this source of error could be eliminated, would be by the bacteriological examination of the fæces of every person suffering from diarrhœa. This is clearly impossible, for several reasons.

In the first instance, quite 50 per cent. of the pilgrims suffer from diarrhœa owing to the bad food, bad water, and hardships they have undergone. Pilgrim's diarrhœa is a well-known disease in the East, and the term appears to include every form of intestinal derangement, from typhoid to cholera. It is clearly impossible to examine the fæces of hundreds of people bacterioligically.

Secondly, among the pilgrims at any rate, there has been found in the intestinal contents of several persons, a vibrio which so exactly resembles the vibrio choleræ that it cannot be distinguished from it by the ordinary culture and microscopical tests. It was discovered at Tor, in 1896, and Dr. Bitter, Dr. Gotschlich, Dr. Galvani and I, who examined the cultures, were of opinion that this was the vibrio choleræ. Later on, however, it was discovered that there was a slight quantitative, not a qualitative, difference in the reaction given by the vibrio, the serum test from the reaction given to the same test by the vibrio choleræ.

This microbe was discovered at Tor at a time when, from personal observation, I can answer for the statement that there was no "clinical" cholera at Tor. The orders had been given that every case of cramp or vomiting should be

at once reported. Every case coming into the hospital with the slightest intestinal disorder was carefully examined, but not the slightest case resembling cholera was discovered. Whether this microbe is a modified vibrio choleræ or not, matters little for our present purpose, but its existence shows clearly that, when one has to deal with thousands of persons, no practical rule can be based on the microscopical or bacteriological examination of fæces short of a serum test.

The fact cannot be too strongly impressed, therefore, that, quite apart from the wilful fraud of those in quarantine and their guardians, quite apart from possible negligence in disinfection, a person can go through a period of quarantine and carry the disease to some other place.

Such are the measures which are taken at Tor against pilgrims. The quarantine station for ships coming from the Red Sea or Far East, and who do not carry pilgrims, is at Moses' Wells, a desert spot situated about six miles from Suez on the Asiatic shore of the Gulf of Suez. The establishment consists of a disinfecting station, two hospitals, a small lazaretto for passengers, and a doctor's house, kitchen, etc.

The disinfecting establishment has two huge disinfecting stoves, baths, douches, hot and cold water arrangements, and is quite a model of its kind.*

The buildings could not accommodate more than about fifty passengers at most, so that in case of a big passenger steamer arriving from an infected port, and seeking *pratique* in Egypt, quarantine must be carried out on board.

All ships arriving from the Red Sea are indiscriminately subjected to medical examination at Suez.

Vessels from a cholera- or plague-infected port are subjected to measures which vary according to circumstances, and which are applied as follows :—

A.—Ships coming from Cholera-infected Ports.

(*a*) If the vessel be healthy (that is to say, if there has been no case on board at the time of departure nor during the passage), it is admitted to free *pratique* after the medical visit, provided that five clear days have elapsed from the time of leaving the infected port.

If the passage has been made within that time, the ship

* I have no hesitation in saying so, as I had nothing to do with the designing or building of it.

is kept under observation until the five days are over. The passengers must remain on board, or be landed at Moses' Wells, and undergo medical examination during their stay. The Council has the right to order disinfection to be done.

This arrangement was specially made by the Egyptian Board with regard to healthy vessels hailing from the Mediterranean, and has hitherto been applied to the same class of vessels from the Red Sea ports.

(*b*) If the ship be *suspected* (that is, if it had on board a case of cholera at the time of leaving port, or at some time during the journey, but not during the last seven days), it is allowed to traverse the Suez Canal in quarantine, on condition of having a doctor and a disinfecting stove on board. Should it not have these, it must be retained at Moses' Wells, near Suez, long enough for the disinfection of dirty linen and other suspected objects, the disinfection to be carried out at the sanitary station there. Afterwards, the ship may cross the canal in quarantine. An exception is made if the vessel is a mail-boat or passenger-boat, without a disinfecting stove, but carrying a doctor, which may pass through in quarantine if the sanitary authorities are fully satisfied that the ship was disinfected, either on leaving the port or during the passage.

A vessel under the same circumstances, which has made a journey of more than fourteen days' duration, is given free *pratique* after being disinfected. If the passage has taken less than fourteen days, the boat and passengers are kept for twenty-four hours at Moses' Wells, and are then given *pratique* after disinfection.

When cholera appears among the crew only, the disinfection is applied to the soiled linen of the crew alone, and is extended also to the crew's quarters.

(*c*) If the ship be infected (that is, if a case exists or has existed on board during the past seven days), and if it carries a doctor and a disinfecting stove, it must return to Moses' Wells, where the sick are disembarked, and the dirty linen, both of the rest of the passengers and of the crew, is disinfected on board.

Should the cholera have broken out among the crew exclusively, the disinfection is confined to dirty linen and to the quarters of the crew.

All persons who have come in contact with the sick are also disembarked, and are kept at Moses' Wells until the completion of five days from date of last attack on board.

The vessel also must remain there until the fifth day

after the last attack; but is allowed to traverse the Canal in quarantine, after landing the sick and suspected persons, and undergoing disinfection.

This disinfection is carried out only in the part of the vessel with which the sick persons have come in contact, and in the sick bay.

The time that the ship is being disinfected is included in the time that it passes under medical observation.

If the boat carries neither disinfecting stove nor doctor, it must go to Moses' Wells to undergo five days of medical observation, to date from the last case discovered on board. The sick and suspected are disembarked, and isolated in the hospital. The other passengers are also landed, and isolated in as small groups as possible, in order that the whole may not become liable, should cholera break out in any one group.

A thorough disinfection of the contaminated vessel is carried out. The dirty linen, vessels and clothes, both of passengers and crew, are alike disinfected. The merchandise is not landed. The passage through the Canal in quarantine is granted, after the disembarking of the sick and suspected, and when the disinfection has been efficiently carried out.

B.—Ships coming from a Plague-infected Port.

(*a*) Healthy ships are admitted to free *pratique*, after the medical visit. They must in all cases have completed, or be about to complete, ten clear days from the time of leaving the last plague-infected port. The dirty linen of the crew and passengers is disinfected. The medical visit is always paid during the day. Healthy vessels may also pass the Canal in quarantine, if continuing to make up their ten days.

(*b*) Suspected vessels (namely, those on which a case of plague occurred on date of departure or during the voyage, but where no new case has supervened for twelve days past) are allowed to enter the Canal in quarantine, on condition of having a doctor and a disinfecting stove on board. If they do not carry both, they may go across the Canal only after the dirty linen and other susceptible objects have undergone disinfection.

Postal or passenger boats, without a disinfecting stove but carrying a doctor, may pass through in quarantine, in cases where the sanitary authorities are satisfied that disinfection has been carried out during the voyage.

Suspected boats which have made a passage of more than fourteen days' duration, are admitted to free *pratique* after disinfection. If the passage is less than fourteen days, the vessels with their passengers are detained at Moses' Wells to complete ten days, after which they are given *pratique* after being disinfected.

(*c*) Infected vessels (or those which either have a case of plague on board, or have had one within the past twelve days) are kept at Moses' Wells, where they land their sick. If they have a doctor and a stove, the soiled linen of the crew and passengers are disinfected on board.

When plague has broken out among the crew only, the linen and quarters of the crew are alone disinfected.

At the same time, all persons who have been in contact with the sick are landed and detained at Moses' Wells, for ten days after the outbreak of the last case on board.

The vessel itself must remain ten days at Moses' Wells after the last attack on board; but it may go through the Suez Canal in quarantine after landing the sick and suspected persons, and being thoroughly disinfected. This disinfection is carried out only in the part or compartment of the ship, and in the section of the hospital, to which the sick persons have had access.

The time taken up by disinfection is included in the period of medical observation.

If the vessel have neither doctor nor disinfecting stove on board, it must return to Moses' Wells to complete (as well as the passengers) a term of ten days from the outbreak of the last case. The sick and suspected are isolated in a hospital, the rest of the passengers are isolated in groups of as few in number as possible, in order that all may not be liable in case the plague should appear in any particular group.

A thorough disinfection of the infected ship is undertaken; the dirty linen, the vessels and utensils, and the clothes of the passengers and crew, are alike disinfected. The merchandise is not landed. The passage of the Canal in quarantine may be be granted after the landing of the sick and suspected, and the disinfection of the ships have been entirely carried out.

The Board has no power over merchandise going through the Canal, but the rules with regard to merchandise coming into Egypt from plague- or cholera-infected parts are as follows:—

Soiled body-linen and garments, bedding, carpets, sacs and embroideries may be disinfected, or their entrance

prohibited. The same rules apply to any animal refuse, such as hairs, untanned skins, hoofs, &c. Silks and uncarded wools may also be prohibited.

Taking merchandise first, it is difficult to understand why animal refuse, silks or wools should be submitted to any measures, as I am not aware that animals get plague or cholera. The argument that they might bring plague or cholera because they have been stored in dirty places, applies just as well to almost every other form of merchandise.

I do not understand why any restrictions should be placed on any merchandise, except soiled linen and rags. The East has been infected with plague for more than three years, with cholera for many more years; thousands and thousands of tons of merchandise have gone from infected ports to all kinds of places, and, so far, not a single clear case of infection has been traced to merchandise. I am not aware that a single porter who unloads ships in London or Liverpool has contracted plague or cholera; and when plague has broken out on board ships it has attacked firemen and stewards chiefly, who had nothing to do with the merchandise.

The same remarks apply to rats, against which I notice that some nations are taking measures. I am not aware that, up to the present, any ships have arrived at Suez complaining of the presence of dead rats on board. We have not heard that the rats in London or in foreign ports have begun to suffer from plague, although they must have been in contact with rats coming from infected ports. Nay, more: there is evidence that on several of the ships actually infected with plague, no special mortality among the rats has been noticed. Up to the present moment, the evidence that rats may carry plague from place to place or country to country, is purely negative.

We may now proceed to examine critically the measures which affect the passengers. Persons landed from plague-infected ships are allowed to go to their homes after their period of quarantine is over, but their names and addresses are taken down. The native passengers are visited for a certain length of time by the officers of the Sanitary Department of the Interior. The measure is one highly to be commended.

The disinfection of the ships, as ordered by the Convention of Venice, is one which it is not always easy to carry out. The ordinary methods of squirting or pulverising sublimate solution is one in which personally I have no

confidence whatever. In one case, a ship was disinfected twice in that way, and plague cases still occurred; for the fact is, that sublimate has practically no penetrating power whatever on the greasy planks of the sick bay or crews' quarters. In the absence of a good antiseptic, a good wash-down with soap and water, and subsequent flooding with the hose, would be far more efficient; as it would, at any rate, mechanically remove the microbes. The best antiseptic for disinfecting purposes, however, appears to me to be 5 per cent. solution of carbolic acid, to which a sufficiency of soft soap is added. The water is first heated to boiling-point, and the carbolic acid and soft soap are slowly added under constant stirring. This is then well scrubbed in with hand-brushes. Those using it should wear india-rubber gloves, as it blisters the hands dreadfully.

The clothes which have to be disinfected are always to be disinfected by steam under pressure.

It has already been noticed that only a certain part of the ship and the clothes of the crew are disinfected, and that in some cases this disinfection may be carried out without extraneous help by the people on board the ship. Clearly, such rules are little better than a dead letter: for the captain of the ship, in order not to delay his ship, will try and limit the disinfection to the smallest possible space, the crew will hide their clothes—for to a man they believe that these will be spoilt by "fumigation"—so that the advantages of disinfection are minimised.

The disinfection on board ship, carried out by the ship's people, under the supervision of the ship's doctor or chief engineer is, in my opinion, little better than a farce. The passengers do not think of giving up their soiled linen because it is too much bother, and they fear it will be spoilt; and, in one case at any rate, in which I had the opportunity of watching the operation of disinfection as a passenger, the disinfecting stove was not even screwed down. In the other two cases, the passengers laughingly boasted how they had each given one or two pairs of socks or handkerchiefs, or, perchance a shirt, which represented their soiled linen for a voyage lasting almost a week.

The doctor is simply dependent on the word of the passengers, for he cannot, and indeed will not, rummage about the trunks to see that the people have given up their soiled linen; and certainly the passenger's word on such a point is not to be trusted.

An experience of three years of quarantine work is

perhaps not sufficiently large to entitle me to give an opinion on measures which have been signed by the plenipotentiaries of the great and small Powers of Europe. Nevertheless, I may be allowed to express tentatively the opinion which I have formed respecting the way in which the quarantine measures recommended by the Powers do work in practice. At any rate, I have had simple opportunities of seeing that.

Now, I am very strongly of opinion that any measure which is recommended should be such that it can be applied. With regard to the pilgrimage, the measures are fairly satisfactory, because the pilgrims at Tor are, so to speak, in our power, and because time is of little object, and the disinfecting plant is sufficient.

With regard to the measures for passengers entering Egypt, a good deal can be done, because here again the measures can be applied with a certain amount of success. A captain might possibly hide a case of plague or cholera, but should the case be fatal, the suspicions would be aroused by the very fact of there having been a death on board.

The other measures which are taken for suspected and infected ships which transit the canal in quarantine, or are detained for disinfection at Suez, are, in my opinion, useless for the most part, because they are avoided, and, as long as human nature is what it is, will be avoided.

The measures which might be carried out with a fair amount of success are those which affect the sick person only, and not the crew, passengers, and ship.

A ship's captain has no objection to landing a person sick with plague and cholera, and that person's kit. He will only be too glad to do so, as experience has shown; nor will he have much objection to his cot and neighbouring cots being disinfected. But he will try and and oppose any landing of men who have been in contact with the patient, because, if the sick man has been in the same room as his companions, the captain might lose half his crew by the application of this method. I know of one captain who stoutly maintained that no one but the steward had visited the patient, when the visiting doctor had had ocular evidence that most of the crew had been in contact with the sick man.

Similarly with disinfection. The captain does not object to the patient's kit and bedding being disinfected or thrown overboard, but most of the crew and passengers will do their very best to hide everything they can possibly hide. And

indeed there is no reason why they should not, for the measure is absurd in itself.

These measures of wholesale disinfection are really based on the old idea that cholera and plague are conveyed by air; and on that theory it is supposed that a ship becomes infested from end to end by a plague or cholera case. But now that it is known that a cholera or plague patient is only dangerous by his dejections, it is high time that such measures should be abandoned. The disinfection should be strictly limited to (*a*) The linen of the patient, or the bag or trunk in which the linen has been placed. (*b*) The cot and cabin of the patient.

With regard to the landing and segregation of the contacts, it is an excellent measure theoretically, but from the practical point of view, in no case so far have I seen it do any good.

In the case of the "Mehalla"—a ship coming from Jeddah, and in which a case developed plague the day after its arrival at Suez, where it took *pratique*—the ship's doctor, who would certainly not have been landed had the ship gone through the Canal in quarantine, got plague and died. Four of the crew afterwards showed suspicious symptoms, although the ship had meanwhile been disinfected twice with sublimate, but these patients were in no particular relationship to the patient, and would certainly not have been considered as contacts. Their mode of infection was doubtful. No dead rats were found on board till after disinfection with sublimate. There was no evidence to show that these rats had died of plague, but they had probably died from the disinfectants scattered about the ship.

The following is the number of the ships of which I have notes, which had plague or cholera on board before getting to Suez, and the history of the contacts:—

S.S. *Glanson* had eight cases and four deaths of cholera on board from April 27th to May, 1895. Arrived at Suez on May 21st, 1895. No contacts landed.

S.S. *Dilwara* had one case of plague on board on March 18th, 1897. Three persons landed. No case of plague among contacts.

S.S. *Britannia* had three cases of cholera on board. Two of the sick were landed at Moses' Wells on August 16th, 1897. No contacts were landed.

S.S. *Caledonia* had two cases of plague on the day it arrived at Suez. Two contacts were landed, but were not attacked.

S.S. *Dictator* had two cases of plague on board when the

ship arrived at Suez. All the members of the crew were kept ten days at Moses' Wells, but no case of plague occurred among them.

It will be noticed that in two cases the contacts are conspicuous by their absence, and that, as a matter of fact, not a single person isolated as contact developed plague or cholera afterwards. A strict logician would not fail to argue that contacts are less liable to plague than others.

To conclude: I believe that the measures ordered by the Convention of Venice for the pilgrimage are adequate as far as plague is concerned. To a great extent, the regulations can be carried out with a fair prospect of stopping an epidemic of plague, and of sending the pilgrims out free from plague bacilli. With regard to cholera, I am of opinion that a quarantine of several weeks will not ensure safety. One may diminish the chances of infection, but not abolish them; and the only safety is the watching of the pilgrims after their arrival in their homes.

Similarly, the measures applied to the passengers landing in Egypt can be applied with a fair hope of success.

The transit of ships through the Canal in quarantine affords some security to Egypt, but none to Europe, as experience has repeatedly shown.

The measures of disinfection bearing on the linen of the whole of the crew and passengers are, in my opinion, bound to be a failure; because, short of searching and emptying out a whole ship, most of the articles will be concealed. Further, I am of opinion, that such a measure is not expedient, and that the disinfection should be limited to the linen, clothing, and quarters of the sick patient.

Similarly, no person should be landed except those whose temperature is raised, or who are actually showing symptoms of plague or cholera. Experience has shown that those who have been landed because they had been in contact with patients did not get either plague or cholera.

And lastly, my opinion on questions of quarantine, ship disinfection, etc., is that it is better to do a little well and thoroughly, than a great deal badly. That when we remember that it takes five minutes for a surgeon to clean his nails, the disinfection of a large number of persons is not likely to be done satisfactorily in a short time.

The great danger is the patient, the things in his immediate neighbourhood, and his soiled linen, and it is comparatively easy to deal with them; but when an

attempt is made to enforce measures which affect healthy people and entail pecuniary loss, the door is open to every form of fraud, concealment, bribery and corruption. Personally, I feel sure that we should be far more likely to know the truth were it not for the fear of delay produced by quarantine measures. Hence I am of opinion that all measures for ships going through the Canal in quarantine should be abolished, except the landing of the sick and the disinfection of the sick person's quarters and linen.

PLAGUE AT OPORTO.

By A. SHADWELL, M.D.

(*Read: December 15th*, 1899.)

Before proceeding to discuss the present appearance of plague at Oporto, it may not be out of place here to refer to the sad loss of a distinguished colleague and an ornament to the medical profession, who fell a victim to the disease last month. I mean Dr. Camara Pestana, the head of the Royal Bacteriological Institute at Lisbon. While studying cases at Oporto, he himself became infected, but the illness did not declare itself until after his return to Lisbon. It speedily assumed a severe form, and terminated fatally after a short course. I had the pleasure of meeting Dr. Pestana at Oporto, and having seen him at work in the wards and in the laboratory, I formed a very high opinion both of his personal character and of his professional skill—an opinion which I know was shared by the other foreign doctors present. He was a most accomplished bacteriologist, and not less modest than accomplished. Some of the foreign bacteriologists, on being made acquainted with his work, expressed the opinion that its originality and brilliancy would have ensured him a European reputation, if he had written in some less unfamiliar language than Portuguese. His death is a severe loss to Portugal, at a time when she has special need of the scientific knowledge of which he was a master. There is a certain grim irony, such as Fate sometimes loves to display, in the selection of Dr. Pestana for the first victim of importance claimed by the plague; for it was his bacteriological verdict on specimens sent to him for examination which first authoritatively established the identity of the disease.

But besides expressing the sympathy we all must feel, I have another reason for referring to his untimely death. What is said to have been his last—or almost his last—utterance is worth recalling: "We know nothing about plague," he said; "we know no more than they did in former times." Those are striking words, coming from a man of high scientific attainments who had been studying the disease

at first hand in all its aspects, and in all the light of modern knowledge. For some months he had been occupied with it, and his mind was full of it, as an observer and student. Then he was called upon to come in closer and more intimate contact with the enemy, in the passive capacity of sufferer; and, reviewed by the inner light of this involuntary experience, all the knowledge gained by science appeared no better than ignorance. On the theoretical side, it was inadequate to explain why he should have caught the infection; on the practical, it failed utterly to afford that protection or that remedy, both of which had been somewhat noisily claimed for it.

It is a melancholy reflection, but I am afraid it is true, that we do know very little about plague. I have met bacteriologists, indeed, who understand it perfectly, as they do all other diseases, and have nothing to learn on the subject—so at least I have gathered from their utterances. Armed with a cage full of white mice, and a portable stock-in-trade suggestive of the commercial traveller, they are equally ready to explain the origin of an outbreak, to foretell its course, to stamp it out, and to provide an unfailing prophylactic or a perfect cure. The consciousness of this mastery must be a source of great satisfaction to them. But we cannot all rise to such heights; and for my part I confess that, clinically and epidemiologically, plague seems to me a particularly dark and mysterious disorder, the obscurity of which is not lightened by labelling it a "filth disease," or by uttering the word "rats." The facts of the outbreak at Oporto will be found to justify this view.

To go over the whole ground here would be impossible. I propose, therefore, to confine myself to two points: (1) the origin, and (2) the spread of the disease, after first giving briefly such *data* about the locality and the conditions of life as are necessary to make the situation fairly clear. If any gentleman wishing for information on points omitted will kindly ask me, I will do my best to answer.

Oporto is a seaport town of about 150,000 inhabitants, lying on the Douro, some two or three miles from the mouth, and, therefore, almost on the Atlantic coast, from which a refreshing breeze blows nearly every day. The site is exceedingly hilly, and the formation granite rock. The ground for the most part slopes upwards from the water, but at some points it rises precipitously. The annual rainfall is large—between 30 and 40 inches—and very irregularly distributed. The thermometer very rarely rises above 95° Fahr., and still more rarely descends below

freezing point. The town has grown rapidly of late years, and straggles out into the country in all directions. It therefore covers a great deal of ground, and the density of population for the whole municipal area is correspondingly low, being only 16 to the acre.

Though mainly an industrial and commercial town, it contains a large number of wealthy or well-to-do inhabitants, living in isolated villas with gardens. There are plenty of open spaces, and the streets are for the most part of a fair width. The houses are built of the native granite, which is the cheapest building material. They are drained into cess-pits, generally of the roughest construction. There is no sewer system, or none worth mentioning. The water supply is obtained from two sources: (1) a tributary of the Douro several miles away; (2) springs in the town. The first supply is said to be imperfectly filtered, and very dear: it is not laid on to the houses of the lower classes. The latter fetch their own water by hand from the springs, which are arranged so as to issue from the rocks in spouts convenient for filling hand-vessels. There are several such fountains in Oporto. The principal one is in the middle of the town, and on the lower-lying ground. It is always surrounded by a crowd of women, girls and boys, carrying vessels. The people using this fountain come chiefly from the slum area hard by in the heart of the city. It is the oldest part of the town, and rises from the water's edge. Described in brief, it is a regular Oriental quarter, consisting of narrow passages and lanes, with lofty houses on both sides, and abounding in Oriental dirt. Neither air nor light can penetrate; and as the houses stand back to back, or against the steep side of a hill, the rooms to the rear are often without any aperture whatever except the door.

Great overcrowding and extreme poverty prevail among the people inhabiting this quarter. Many of them are Spanish labourers, whose personal habits are less cleanly than those of the Portuguese. A shilling a day is considered a fair wage for an able-bodied man, and the price of food is by no means correspondingly low. The poor never eat meat, and often cannot buy wheaten bread. Their staple food is salted cod from Norway and Newfoundland, fresh sardines, Indian corn and rice. During the harvest year there was a marked falling-off in the importation of salted cod, the price of which rose accordingly, and accentuated the normal condition of semi-starvation.

The mean annual death-rate is upwards of 30 per 1000;

in bad years it rises to 32 or 33. Bearing in mind the conditions previously mentioned—namely, the hilly situation, the nature and lie of the ground, which tend to make the soil dry, the ample space, the constant sea-breeze, and the considerable proportion of well-to-do inhabitants, one recognises in the high general death-rate proof of extreme unhealthiness in other respects. It is probable that if the death-rate in the slum area were worked out it would prove to be double. The chief causes of death are tuberculosis, which is excessively rife in Portugal, and notifiable as an infectious disease; other affections of the respiratory organs, particularly the broncho-pneumonia of children, and diarrhœa. The infant mortality is very high, and typhoid fever seems to be generally prevalent. Measles are very destructive among children.

Such are the chief facts relating to public health in this European city, in which plague appeared last summer after an absence of 200 years. Dr. Jorge, in his recently-issued report says 300 years, but I think that must be a mistake, as I find, in the statute book of public health regulations, kindly presented to me by the Ministry of the Interior, royal orders relating to plague issued in 1680 and 1695. Possibly, however, it was then confined to Lisbon. At any rate, Oporto has been free as long as England and the rest of Western Europe. Its reappearance in the present year was discovered by the vigilance of the medical officer of health, Dr. Ricardo Jorge. And here I should like to say that, whatever be the sanitary drawbacks of Oporto, it enjoys a compensating advantage—the possession of an extremely able, zealous, and courageous medical officer. It will not surprise the present audience to learn that his post is hardly a bed of roses. That of a medical officer who tries to do his duty in such a town as Oporto seldom is. He is apt, unless I am misinformed, to meet with a certain amount of opposition and criticism. I believe that such things have been known, even in this enlightened country. But Dr. Jorge has had a more than commonly trying task to perform. It is no light responsibility to proclaim the existence of plague in a sea-port town dependent for its prosperity on maritime commerce, and that in a country so wedded to the antiquated systems of prophylaxis by restriction of intercourse as Portugal. In taking it upon himself, Dr. Jorge had to meet, not merely the inevitable hostility of the commercial interests, but also the semi-Oriental ignorance of the mob; and, what was even worse, the scepticism and opposition of professional colleagues.

As for the behaviour of the authorities and the measures taken to meet the emergency, I shall say nothing about them, but they must have been heartbreaking to a man of his knowledge and earnestness.

His account of the discovery is this:—"Being informed," he says, "that some unexpected and consecutive deaths had taken place in certain houses in the rua Fonte Taurina, I proceeded, although the certificates of death assigned normal causes, to visit and investigate the incriminated locality on the 6th of July. The result of my inquiry was the discovery of an epidemic outbreak of some grave and unusual illness." I gather from this that Dr. Jorge's attention was called to the matter by the death returns for the month of June. In that month four adult persons had died in the street in question—two in the same house; and presumably the stated causes of death did not satisfactorily explain the occurrence. A thorough investigation, carried out with some difficulty on account of the fears and suspicions of the people, enabled him to trace back the commencement to the 5th of June, when the first case occurred in one of the houses in this street, namely, No. 88.

Now, it was said at the time, and has been repeatedly said since, that this was not the real beginning: that the thing had been going on a long time before, even for years, only that it was called by another name, such as typhoid fever. Doctors have declared that they had often treated patients before, suffering from exactly the same symptoms as those subsequently isolated in the plague hospital. Well, we know that it is often—indeed, almost always—impossible to fix with perfect certainty the beginning of any invasion of infectious disease in a large town, and that plague in particular is exceedingly insidious in its mode of attack. It was Heberden, I think, who says that "On its first breaking out it is never known to be the plague." Still, it can be traced backwards by careful inquiry to somewhere near the beginning, with at least approximate accuracy; and, I am inclined to think that Dr. Jorge has done so in this case. It is reasonable to suppose that, if it did not escape his vigilance in July, although on so very small a scale, it would have been detected earlier by the same watchfulness, if it had existed earlier in the same form. As for the doctors who profess to have seen and treated an identical illness for a long time previous, I am afraid the admission robs their evidence of any value; for if they could go on treating such cases

without recognising them to be plague, their powers of observation must be—what shall I say ?—very moderate.

Dr. Jorge himself, being in a better position than anyone else to examine all the facts, and having done so very carefully, has failed to trace any illness back beyond the date mentioned. He has not thought it worth while to answer all the criticisms and rumours of the previous prevalence of plague; he has quietly put them aside. He is independently corroborated in fixing the earliest appearance of plague in a fatal form in June, by the fact that it was first noticed by the people themselves: among whom this unaccustomed form of illness became so much the subject of conversation, that it came to the ears of a member of an English shipping firm, who actually recognized the disease from the description given by the unconscious dockers. From him it found its way into an English medical journal—the *Medical Press*—before any public announcement had been made. To these working men, at any rate, the buboes and other symptoms were quite a new thing last June, and discussed among them as such.

I have dealt at some length with this point, because it has an obvious bearing on the question of origin. If the time and commencement can be fixed within moderate limits, it narrows down the field accordingly; whereas, if it is to go back indefinitely for years, a hopeless vista is opened up. On the whole, though absolute certainty is impossible, we may say that careful inquiry has failed to trace the existence of plague prior to the first week in June.

The earliest known case was that of a Spanish labourer named Gregorio Blanco, who worked as a porter on the ships and warehouses—what we should call a docker. He lived at No. 88, Fonte Taurina, and was employed in the salt-fish warehouse of an English firm. He had been complaining of a pain in the right side, and, according to a medical man who saw him, he had a swelling in the right axilla. On June 5th he returned from work, silent, and stumbling in his walk. His mates thought him drunk, but he was obviously very ill. He went to the latrine, but did not return, and was afterwards found there dead. A whole batch of cases followed this one, all more or less closely connected with it—namely, four in the same house, three next door, four opposite, and others among the friends and relatives. The Fonte Taurina is a short, narrow, and filthy street, parallel with the river. It is

inhabited entirely by labourers, hawkers, and the lowest class of small traders; but it contains warehouses and offices, including those of the British Consulate and some wealthy shipping firms.

Now, how did the infection of plague get into this place? The *primâ facie* supposition of importation by sea is very strong. Here is a seaport, and plague appears down by the water, among the men employed on the ships. Added to that, Gregorio Blanco was said to have been at work, just before his seizure, on a cargo of grain. You have only to assume that the grain is from India, and you have a very pretty combination. On investigation, however, a large part of it disappears, and there are big holes in the rest. According to my own inquiries, Blanco was not at work on a cargo of grain, but in the salt-fish warehouse. I cannot, indeed, find that there was a cargo of grain at all, except one from New York on May 23; and that negative result is confirmed by the discrepancies in the various accounts of it. Some say it was rice, others maize, others hemp. In any case, it did not come from India, or from any plague-infested port direct. For this is the most singular feature of the whole occurrence: Oporto has no intercourse with India, China, Egypt, South, East, or West Africa, or, in short, any part in which plague existed at the time. I found this fact out for myself by an inspection of the shipping register, and it is confirmed independently in Dr. Jorge's report. The bulk of the trade is all with London and other English ports, Hamburg, Rotterdam, Havre, and Peninsular ports. A very few ships come there from the Mediterranean, but only from Batoum (petroleum), Odessa, and Tangier. As to goods, the regulations provide that if they come from infected parts, they must lie for three months in a clean port before being admitted to Oporto.

Any grain, therefore, must have been handled and warehoused elsewhere before shipment to the Douro. This involves the impossible supposition that a cargo that was harmless in the Thames or the Elbe had become dangerous in being sent across the Bay of Biscay. The same argument applies with still greater force to the theory of infected rats, which has also been advanced because the ships lie out in the river, not alongside a quay or wharf.

We are asked, in effect, to believe that the rats picked out a place where they cannot get ashore, and carefully refrained from infecting other ports of call where they can, and also the ship itself. Whichever way we look at it, the

difficulty remains that the infection has passed by a large number of sea-ports much nearer to Eastern foci, or having far greater and more direct intercourse with them, and has pitched upon a little fourth-rate place, which has only a comparatively small sea-borne traffic, and none at all with the centres of infection. As Dr. Jorge says, it is a "flagrant etiological absurdity," and quite inexplicable in any theory of conveyance. The failure to trace importation is, of course, nothing in itself: the unintelligible thing is that it should have occurred in the absence of any visible channel, while so many other places exposed to incomparably greater liability should have escaped.

If plague moves gradually it would have appeared first in some of the Mediterranean ports; if steam transit permits rapid conveyance over long distances, the great ports of arrival from the East would be the points of attack. We are almost forced to one of two conclusions: either that plague was not imported at all but bred in the place, or that the apparent immunity of other ports is not real; and that if the same vigilance and candour were exercised elsewhere as in Oporto, it would be found to have companions in misfortune. Whatever hypothesis be accepted one thing is clear, namely, that plague is a most insidious enemy, and capable of making its appearance where there is no reason for expecting it.

There is one other observation I wish to make on this part of the subject. I do not lay any particular stress on it, as it may be a mere coincidence; but all facts have their value, and the coincidence is at least curious. The people among whom the plague first appeared work among salt-fish, and live upon it; and the same thing is true of the very remarkable and isolated outbreak which occurred on the lower Volga in the winter of 1878-9—an outbreak which the British Commission of Inquiry were inclined to think was not imported.

The inhabitants of the villages affected live by curing fish, and presumably—though I do not know it for certain—this also holds good of the similarly-isolated outbreak which occurred in the same region this year. We have, therefore, two if not three isolated manifestations of plague with this peculiar feature in common. It would be interesting to know if there is anything of the kind connected with those localities where plague appears to spring up every now and then without any apparent reason—on the Euphrates, or in China, for instance. The salted cod-fish consumed in Oporto is, I may say, a very

peculiar viand, and a decidedly acquired taste. It appears at the hospitable table of the English club there, but such is the odour and flavour of the dish, that a stranger who can face the ordeal successfully is regarded with some surprise, if not resentment. Attacked boldly in the orthodox manner, however, with raw garlic, it forms a peculiarly seductive introduction to the consumption of port wine, and thereby justifies its existence; but the poor, I need hardly say, have to eat the fish without the antidote.

Passing on to the spread of the plague, I will return to the batch of cases previously mentioned. Gregorio Blanco died on June 5th, at 88, Fonte Taurina. With him, on the second and third floors of the same house, lived three other Spanish dockers. They attended to the body of their compatriot, and buried it. All three caught the disease, two falling ill on the 15th and one on the 28th of the month. The last was taken to the General Hospital, and died there after about ten days' illness. The other two recovered, and one of them, being frightened, went back to Galicia. All had fever prostration and buboes, two of them in the axilla, as in Blanco's case, and one in the groin. In the same house on the first floor lived a fifth Spaniard, with his wife and a young girl. They keep a sort of shop on the ground floor. The man was laid up in bed with facial neuralgia at the time of Blanco's death, but notwithstanding, he fell ill about ten days afterwards with rigors, fever, extreme prostration, and inguinal bubo. He recovered. His wife and the girl escaped entirely. Five cases, therefore, occurred in this one house; and meantime there had been others.

On the day after Blanco's burial, another friend of his who had assisted, fell ill with fever, delirium, and axillary bubo. He lived in the Escadas das Verdades, and was also a salt-fish porter, but not employed in the same warehouse. He recovered, but slowly, imperfectly, and with much weakness, which incapacitated him from work. In his case the connection was personal, not local. Then we have two cases at No. 84, Fonte Taurina, immediately adjoining No. 88. On the second floor lived another Galician docker, with his wife. She fell ill first on the 15th June, with axillary buboes on both sides and a carbuncle. Being some months advanced in pregnancy she aborted, and died on the 17th. On the same day her husband fell ill, and moved to No. 70 in the same street. He suffered from fever and axillary bubo, and died on the 21st. He also

worked in the salt fish, and was the friend and companion of the others. After this come two very interesting cases, namely, two little girls living at Argoncilhe, a suburb of Oporto. Their father slept during the week at No. 70, Fonte Taurina, where the last case died, going home over Sunday. He was also a Spanish docker. The first of the little girls, aged seven, fell sick on the 17th with fever, delirium, and buboes in both groins; the second, aged eleven, two days later. Both recovered. It seems impossible to doubt that their father brought the contagion with him from the centre in the Fonte Taurina, and communicated it to them though he remained quite well himself. In the house, No. 70, in which he slept, and in which the man from No. 84 died, four other cases subsequently occurred.

We next find the field of operations enlarging a little. A Portuguese barber in the rua dos Mercadores, whose shop was frequented by the Spanish dockers, fell ill with the usual symptoms, and another salt-fish porter in the Escadas dos Guindaes. The last was a very marked case, and was isolated in the General Hospital, the existence of plague being by that time suspected. The next victim was the wife of a barber, living over the way, opposite to No. 88, Fonte Taurina. A prominent feature in her case was excessive pain in the head, together with diarrhœa, which was also present in many other cases. She began to improve after three days in bed, and an axillary bubo only made its appearance when she was convalescent.

The foregoing cases, with two or three more which need not be specified, make up what may be called the first batch. The attack was clearly in the nature of a small epidemic, originating in the Fonte Taurina, and the connection between the cases is obvious; they were all in more or less close contact as relatives, near neighbours, or friends. After this, however, a change set in.

The original focus seems to have become exhausted, and no more attacks occurred in that street. Instead of an epidemic advance, isolated cases began to appear here and there in an irregular fashion, and at greater distances from the seat of origin. In some of them, a possible connection is traceable. For instance, one was a woman who sewed sacks for the shipping; another was a boy employed in a bakery; and several others were connected with the flour and bread trade. Those in the rua da Fabrica, for instance, which is at a considerable distance from the river, are cases in point. This is the only striking link of connection, and it is very suggestive; but it does not at all account for the

great majority of the attacks belonging to this period. The persons affected include a very wide range of residence, and an equal variety of occupation. There were clerks, artizans, shopkeepers, dressmakers, domestic servants, and even persons in a superior class of life. They are scattered over an ever-widening area, and it is impossible to see any connection between different groups. The most remarkable feature, however, is the comparative immunity of the slum area in the neighbourhood of the Fonte Taurina.

Whatever channel of communication may be thought probable, it would apply to this part with greater force than to any other; and here also the conditions believed to be most favourable to plague—namely, poverty, overcrowding and dirt—exist in their greatest perfection, greater even than the Fonte Taurina. Yet, very few cases occurred there, as the accompanying spot-map shows. There is no evidence of conveyance by animals, so far as I am aware. Cats may possibly have something to do with it, as they are mostly ownerless, and great prowlers. Dr. Jorge told me of one cat which had the plague, in a nobleman's house, where two menservants had it. As for rats, the distances are too great, and in most houses there are no rats. I have not been able to learn that any mortality has been observed among them. Conveyance by personal contact seems to have been the most important factor, and after that possibly articles of food. But I confess that to me the facts appear most puzzling, and the more closely I examine them the less intelligible I find them.

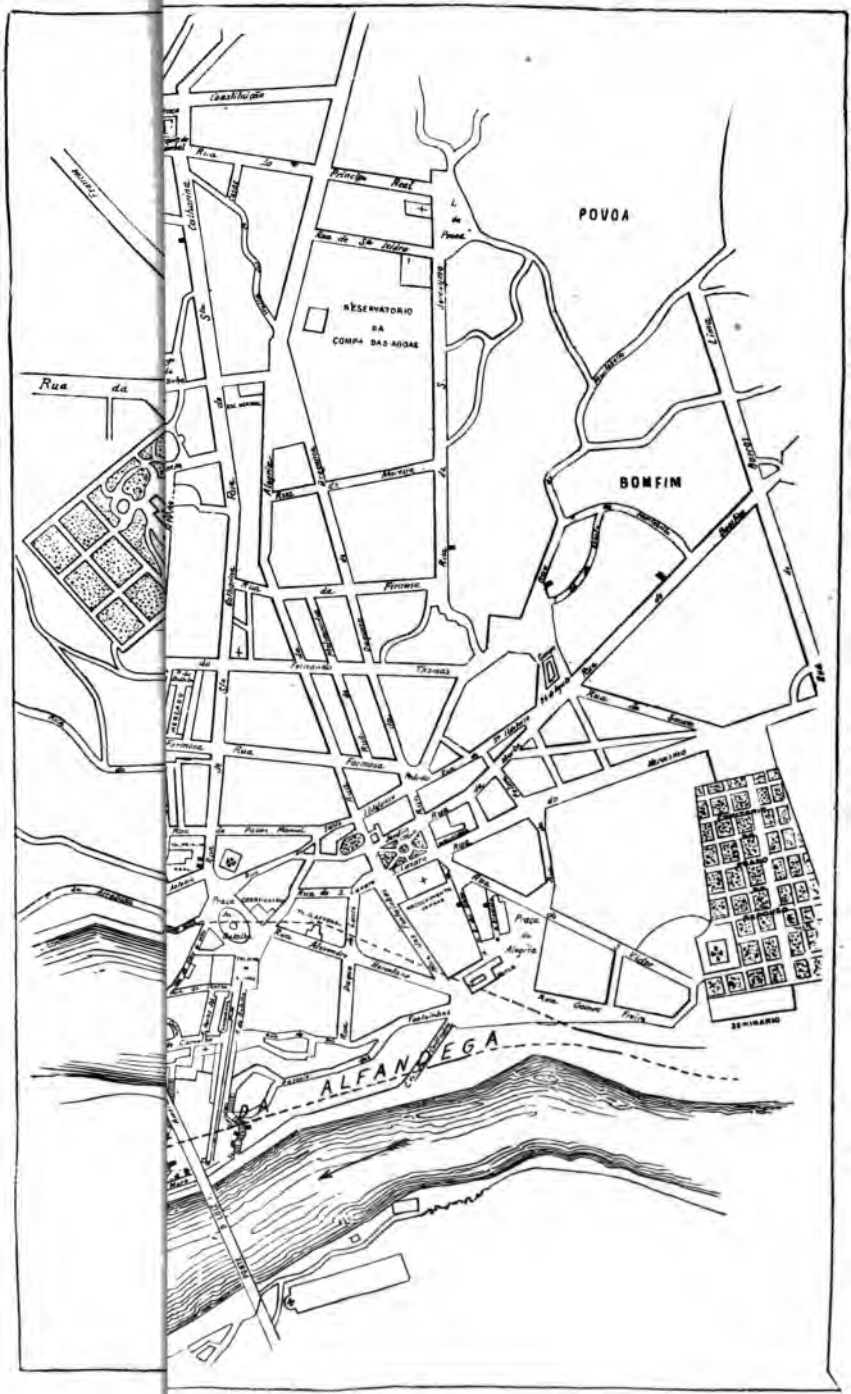
I will conclude with a few figures. The total number down to the end of November is—

Cases.		Deaths.
277	...	97 = 35 per cent.

Monthly Distribution.

June	...	17	September	...	57
July	...	10	October ...	...	95
August	...	36	November ...	...	62

Nine isolated cases were reported at Baguin, a village about twelve miles from Oporto, but I understand that some doubt has been thrown on the diagnosis. Two cases, directly imported from Oporto, occurred at Braga, a manufacturing town some forty miles to the north, and one—that of Dr. Pestana—at Lisbon; otherwise, I believe, nothing has been seen of plague outside Oporto. So far, the attack appears to be quite local.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PLAGUE.

SOME PREVENTIVE MEASURES ADOPTED IN THE PRESIDENCY OF MADRAS

DURING THE LATE

EPIDEMIC PREVALENCE OF PLAGUE IN INDIA.

By J. SPENCER LOW, M.B., Ch.B., B.Sc. ;
Metropolitan Asylums Board, North-Eastern Hospital ; late Medical Officer of the Plague Camp and Railway Inspection Station, Jalarpet.

(*Read: December 15th*, 1899.)

The Presidency of Madras, whether from its geographical position or as a result of the preventive measures adopted by its Government, has not suffered so severely from epidemics of plague as have some other parts of India. Though during 1897, 1898, and 1899 plague raged in one or another place on the frontiers of the Presidency, yet the number of cases which resulted from the repeated importation of infection was relatively by no means large. The Native States of Hyderabad and Mysore, both of which adjoin the western border of the Madras Presidency, are in constant communication with it by road and rail. In these two Native States, with a combined estimated population of about 17 millions, up to June 30th, 1899, 20,000 or more plague deaths occurred; while in the Madras Presidency the total number of plague deaths up to the same date in an estimated population of nearly 36 millions, was only 2092; and these were spread over no less than thirty-seven districts or municipalities, of which the city of Madras yielded only some eleven plague deaths.

Having had the advantage of being employed on plague duty in India during part of 1898 and 1899, I have thought it might prove of interest to this Society if I were to briefly sketch some of the plague preventive measures which were carried out in the Presidency of Madras.

Among the principal measures adopted by the Government of Madras, in their endeavours to prevent the spread of plague, were the following :—

(1) The isolation of plague cases in plague hospitals.

(2) The segregation of "contacts" in camps.
(3) Evacuation and disinfection of infected houses.
(4) Medical inspection and detention for observation of travellers by road and rail.
(5) The passport system.
(6) Inoculation by Haffkine's prophylactic.
(7) The prosecution of measures of sanitary reform.

The following is a short description of these measures, most of which are closely associated with one another, especially medical inspection, detention of travellers, and the passport system.

(1) Isolation of Plague Cases in Plague Hospitals.

The house of the average native of India is no place for a case of infectious disease: not only on account of the ignorance of the attendants on the sick, but also on account of the invariable overcrowding of the house, and the almost universal absence of medical attendance, European or native. The "family" of a native includes not only his wife and children, but many other more or less near relatives.

At the commencement of an outbreak of plague in a locality, as long as the cases are few in number, removal to a well-conducted and equipped plague hospital is the best course of procedure. The patient is allowed, in India, to have two or three of his immediate relatives with him, who may nurse and treat him as they like, medical treatment by Europeans not being insisted upon if distasteful to the patient or his family. This course, coupled with evacuation of the infected house, and disinfection of it and its contents, is best calculated to prevent the spread of the disease. Were it possible to so treat all the early cases of an epidemic, the chances of arresting its further development would be great. But when the outbreak assumes such proportions that the hospitals are overcrowded, and numbers of moribund cases are removed there—possibly greatly against the wishes of patients' families—the people become terrified, and alarming rumours are spread broadcast among the natives as to what is supposed to go on in hospital.

The result of this is that plague cases are concealed, dead bodies are buried secretly under the floor of the house, or in the nearest convenient piece of ground; or the corpse is placed outside a neighbour's house, or thrown into his

well. If the segregation of contacts is actively enforced, the innocent neighbour is conducted to an observation camp, and made to undergo a period of observation, in spite of his indignant protests. The fear of segregation, as well as the fear of removal of the case, prompts the relatives to seek some method of concealing the illness; and in many places in India the authorities have been seriously hampered in their plague campaign owing to this concealment of cases.

Home segregation of plague cases under suitable and efficient supervision is calculated to combat these abuses, but it has to be very carefully applied. It has been found that no matter how simple these restrictions are, they are broken and evaded by all but the better-class natives.

By a process of education, in many places, such for example as Bangalore, the plague hospitals in course of time became less unpopular, and, except among Mohammedans, there was not much objection to removal of the patients to hospital. In Bangalore, home segregation was usually fatal to the patient, except among the better-class natives, and the restrictions were almost invariably violated.

(2) Segregation of "contacts" in camps.

The segregation of "contacts" implies removal of such persons to observation camps, and their detention there for ten days, under medical supervision. Communication with the outer world is prevented by police or Sepoy guards. Within these camps the people are housed and fed for the prescribed period, and are examined daily by medical officers. In these camps, caste prejudices and the privacy of females are the two great sources of discontent and difficulty, and both have to be carefully respected and provided for. The Sanitary Commissioner of Madras, Lieut.-Col. W. G. King, I.M.S., holds the view that no "contacts" should be segregated if they can be trusted not to abscond. He would have them duly observed daily for ten days, under penalties for evasion. This opinion is not held by the Government of Madras. The value of segregation of contacts is doubted by the Bangalore authorities. They only succeeded in securing 2485 plague contacts in connection with nearly 6000 plague *deaths*. The number of plague *attacks* officially reported during this period was only some 4000, but as there was an excess of 5767 over the average num-

ber of deaths from August to December, 1898 (and at this time the ordinary population was much diminished on account of the exodus due to plague), when plague was at its height, and quite out of hand, it follows that there must have been many more than 4000 plague attacks. Although it is impossible to calculate the number of contacts owing to the number of attacks being unknown, it will be seen from the figures given, that only a relatively small number of contacts were secured. Out of these 2485 contacts, only 76, or 3·06 per cent., developed plague. The feeling stirred up by measures of segregation, and the comparatively small number of plague cases detected among these "contacts" seem to show that segregation, as employed in Bangalore, was a failure. Segregation can only do more good than harm when completely carried out. In the early cases, when there is a possibility of the disease being checked, and at the end of an epidemic, when the last remnants of infection must be stamped out, segregation doubtless is valuable. But when it terrifies the people, so that they flee from the bedside of their relative attacked by plague, and spread over the country, it would appear to be a mistake. Prompt disinfection, and daily inspection of "contacts" at their own homes, seem to be the only possible measures when the epidemic assumes formidable proportions. By this means the natives are not alarmed, neither would they scatter over the country: at any rate, to nothing like the extent they would otherwise do, if they knew that every "contact" would be forcibly removed to an observation camp.

At one time it was thought that the collection in camp of large bodies of people who have previously been exposed to plague infection, would involve danger of an outbreak of the disease in the camp, and would thus establish fresh foci for the dissemination of the disease. There does not seem to be much danger of this. In the Jalarpet observation camp, of which I was medical officer, some 11,500 persons were detained for observation, disinfection, or both. A large number of these people, all from infected areas, were detained for ten days. Among these were many suspicious cases, and about fifty who remained in the observation camp one or more days before being finally diagnosed as plague and sent to hospital. Some of these showed no symptoms for a few days after admission to the camp, but were clearly proved on investigation to have contracted the disease outside, finishing their incubation period in the observation camp. Suspicious cases were isolated in the

observation camp as far as possible, but in many cases this was merely nominal: for neither could the police guard nor the people in camp understand the danger, nor could they be prevented from mixing as soon as the medical officer or hospital assistant was out of the way.

Even under these circumstances, not a single case occurred which gave rise to any suspicion that the disease had been contracted in the observation camp. Theoretically, a "suspicion" camp might have been formed for such cases, but in practice there were no grounds for supposing that any infection had taken place, and this partial isolation seemed to be efficient. When a plague case was removed from the observation camp, the hut occupied by the patient was thoroughly disinfected with perchloride of mercury (1 in 1000), and whitewashed. It was then allowed to dry, exposed to the sun for a day or two, and then brought back into use.

Although most plague patients took two or three of their family to the plague camp with them, as attendants, none of these contracted the disease at Jalarpet; neither did any of the staff, which, inclusive of the police, numbered some 100 souls. Even in Bangalore, in one hospital only one native hospital assistant and a few menials were attacked, although 956 plague admissions took place in this particular hospital; and in another hospital 768 admissions took place without a single case among the staff.

In the Jalarpet plague camp, which was in a non-infected area, deriving its cases from passengers removed from trains arriving from infected areas, there were many rats in the plague hospital, which used to visit the neighbouring fields, and probably the little scattered villages a quarter of a mile off; no dead rats were ever seen about the fields or camps, nor were there any plague cases produced indigenously. Although infectious matter was present in the hospital, it was dealt with in such a way (by incineration and corrosive sublimate 1.—1000) that rats, so far as is known, were never infected. It may be of interest to note that patients in the plague camps used to be awakened in the night by rats running over them. Captain Leumann, I.M.S., holds that the bacilli of plague are only found in bloody urine, bloody sputum, and bloody fæces. If a case is recognised early, and the discharges from the patient efficiently dealt with, the infection of rats and the spread of plague by their agency would appear to be impossible.

(3) Evacuation and Disinfection of Infected Houses.

Wherever a building became infected with plague, whether from the occurrence of an actual attack therein, or from the fact that dead rats, squirrels, or monkeys were found in the house or its vicinity, in many places the inhabitants were removed and segregated in temporary shelters for a week or two, the house being disinfected. The opportunity of compelling persons to vacate insanitary property was seized wherever possible, especially upon the occurrence of a plague case. The method of disinfection employed was to drench the walls and floors with mercuric chloride 1—1000. The disinfecting staff were directed to collect all excrement, sputum, &c., mix with some combustible material, and burn them. All rags, clothes, and bedding stained with the discharges of plague patients were similarly treated, compensation being given in some cases. Earth floors were dug up and walls were whitewashed. Native patients have a habit of expectorating upon the walls of their rooms, or into the hands of relatives held up to form a spittoon. In this way infective discharge may be freely carried about the house and elsewhere.

In many places houses were unroofed, partially or completely, to admit sunlight and for free ventilation of the house after evacuation. It is of importance to remember that the chief haunt of rats in a native house is under the roof: hence the necessity of attacking completely this part of the house, as well as the lower rooms. Native houses are very badly ventilated, and in the houses of Mohammedans especially, the windows are stopped up with cloths to afford privacy for their women.

During the rainy season houses are disinfected, as above, but not unroofed, holes being made in the walls for ventilation.

Compensation was given to tenants where such damage was done to a house, as in untiling, that the man had to lay out funds to secure repair; but not where Government servants unroofed and subsequently re-tiled the house after a proper interval. In dealing with the houses of natives, the privacy of their home has to be respected. This is a great obstacle in evacuation, and the importance of evacuation has to be carefully instilled into the minds of the people. When properly put to them, it has been found that such difficulties

can usually be overcome, and evacuation is agreed to. Wherever there is a chance that evacuation may become necessary, it is well to try and get the people to build caste camps for themselves in the fields, so that when it does become necessary, all arrangements are made, and caste difficulties are averted. It is almost the universal experience to find that a plague epidemic ceases in a village after evacuation into huts in the fields. The sick are isolated apart, and the people live for a few weeks in the fields, until their houses have been disinfected and freely exposed to the sun and wind. During the first few days after evacuation, isolated cases occur, from previous infection, but these cease in a few days. Evacuation, however, is not universally practicable, depending for its efficiency upon (1) the *weather*: for during the rainy season, when the epidemic is usually at its height, camping out is impossible; (2) the *character, habits*, and *status* of the people—for an urban population have great objection to camping outside their town; and lastly (3) upon the *labour available* for building temporary structures for the people; because in times of plague the sanitary staff are overworked, and labour is difficult to get, unless the people themselves erect the shelters from material supplied by Government.

Some very satisfactory instances of the efficacy of evacuation are seen among troops. In Bangalore it was found necessary to carry out this measure in the case of a native regiment and the native followers of several British regiments and batteries. In all cases, further development of plague was arrested after evacuation except during the first few days. To take another Bangalore example: the suburb of Knoxpett, inhabited by a low-class population of 1700, was attacked; cases occurred persistently until the suburb was evacuated, only three cases occurring afterwards, all within the next five days. This is the general experience of evacuation.

(4) Medical Inspection and Detention of Travellers.

(*a*) *By road.*
(*b*) *By rail.*

(*a*) *Road Inspection.*—Road frontier inspection stations are maintained on main roads running from an infected to a non-infected area. Behind the inspection station are two rows of observation circles, each of five miles radius, and each under the charge of a plague sanitary inspector, whose duty is to patrol his circle systematically, in order to gain early

information of a case of plague, to check the possession of passports, and to keep a record of all persons suffering from fever continuous for more than twelve hours. All persons entering a non-infected district from an infected area are inspected by a hospital assistant at the road inspection station, and are detained there for observation if they are judged to be suspicious of plague. These are kept under observation at the station, and the nearest medical officer sent for. Those persons who are not suspected of plague are given a passport which binds them to appear daily for ten days before the local authority at their destination. Travellers who do not seem likely to observe the rules under which they would be allowed to proceed freely under passport, complete a ten days' observation at the inspection station. It will be seen, therefore, that the system of medical inspection and detention of travellers is intimately associated with the passport system.

The utility of an inspection station, whether on road or rail, depends almost entirely upon whether every person passing through it is inspected or not. If it is a railway inspection station, it is comparatively simple to ensure the inspection of every passenger by locking the carriage doors, and refusing to allow persons to alight at stations short of the inspection station, unless they can show some proper business at the place at which they attempt to alight. But the justification for the existence of a road-inspection station must depend chiefly upon its topographical position. In hilly parts, it will be found that roads from one district into another tend to go through passes bounded by rocks, jungles; forests or rivers. Under such circumstances, the traveller wishing to avoid an inspection station finds it a difficult and often dangerous matter to leave the road. For instance: the road between the Mysore State and the district of Malabar is bounded by a belt of forest inhabited by wild beasts of different kinds. A river may be a source of strength in the rainy season, but fordable during the hot weather. Where travellers can leave the road, and avoid an inspection station by making a détour through jungle paths, the essential point of inspection of every traveller is done away with, and the existence of such a station is useless. Some of the road-inspection stations in the Presidency of Madras were situated in such places, and were useless; whereas others, better placed, did excellent work.

Intimation of the passage of travellers was sent to their respective destinations to ensure their observation; and the

plague inspector in charge of the observation circle into which the traveller proceeded, supervised their observation.

(*b*) *Railway Inspection.*—Railway inspection stations are instituted at important points on the railways, not only in Madras, but in numerous other parts of India. The traveller from Bombay to Madras, a distance of some 900 miles, is inspected four or five times on the journey, and receives a passport* at a station a few miles outside the city of Madras, or wherever his destination may happen to be. Similarly, travellers from other plague centres, such as Bangalore and Mysore, are several times inspected on the way, and receive passports at their destinations.

It has to be mentioned that certain areas are declared "infected" by the Government of India. This list is changed from time to time, as plague leaves one locality or attacks another. It is, in relation to localities, upon this list that plague measures at railway stations are conducted.

Inspection stations are situated at convenient points between infected and non-infected areas. All passengers holding tickets from stations in these infected areas (such as, for example, the Mysore State, the whole of the Presidency of Bombay, the city of Calcutta, certain districts in the Presidency of Madras, and in the State of Hyderabad) have their tickets punched with a distinctive mark at railway inspection stations, after their medical inspection has been completed. On arrival at their destination, each passenger with a plague-punched ticket is given a passport, by the passport-issuing authority, which binds him to appear daily for observation for ten days. To further insure that each person from an infected area receives a passport at his destination, each passenger's name and address are taken at certain inspection stations, of which Jalarpet, where I was attached, is one. This "intimation slip" is sent on at once to the local authority at the passenger's destination, and the passports issued there are verified with the intimation slips. Of course there are many evasions, varying in the different districts from 3 to 10 per cent., but many of these are subsequently traced, and the evading passenger is prosecuted, when possible, under the Epidemic Diseases Act (India), 1897.

The procedure at a train inspection is as follows:

The train from the time it enters the station is under the absolute control of the plague authority, no one being allowed to approach or leave the train, until permitted to do so by the inspecting medical officer who is the plague

* For information as to passports, see p. 78.

authority. The carriage doors have in all cases been previously locked at the last stopping station, and police are posted on the off-side of the train to prevent surreptitious escape and evasion of inspection. The medical officer's duty is to satisfy himself that there is no case of plague in the train, and that no suspicious cases are permitted to proceed further on their journey. The suspicious cases, after detention and due observation for several days, while the diagnosis is settled one way or the other, are either allowed to proceed or are removed to the plague hospital, as the case may be. First and second-class passengers are examined in their carriages, their temperature being roughly taken by feeling the skin of the hand. They are put to practically no inconvenience. All third-class passengers are compelled to alight, carriage by carriage, the space before each carriage being roped in, and the passengers ranged around the rope in a single rank, with the women grouped at one end of the space for the nurse to examine. The medical officer then goes round the rope, feeling the skin of the arm of each passenger. In cases of a suspected rise in temperature the thermometer is employed, and if the suspicion of fever is confirmed, the person is conducted to a shelter on the platform for fuller examination.

The points which are regarded as of importance in the examination of railway passengers for plague purposes are as follows:

(*a*) The temperature.

(*b*) The gait and aspect of the patient.

(*c*) The condition of the glands.

(*d*) Other signs of the disease, as the condition of the tongue, and conjunctivae.

(*a*) The *temperature* is the point first noted, and if found at the medical inspection to be normal, the passenger is allowed to return to his carriage. Very rarely, cases with normal temperatures and discharging buboes of some standing are found, but their detection is more or less of an accident; it would be almost impossible to examine all the glands of four or five hundred passengers in a train. The first step in the examination, therefore, is to observe the temperature, which in plague cases may range from slightly above normal at the very commencement of the attack, to 105 deg. Fahr. or more, in the case of a patient at the height of his attack.

(*b*) The *aspect and gait of the patient* are in many cases diagnostic. On walking, he lurches as if he were drunk; and if asked to stand still, his body sways in a very notice-

able manner. In cases not so markedly ill as this, great weakness and prostration is frequently displayed, the patient often fainting on examination. The staggering gait, weakness or prostration, with an increased temperature, with or without tenderness in the groin or axilla, are among the earliest manifestations of the disease.

(*c*) The *lymphatic glands* are next examined. The groins and axillæ are the commonest sites of buboes, then the neck; and among the rarer sites are the popliteal space and the bend of the elbow. Hard circumscribed swellings may be met with in the calf and in the middle of the back, one of which I saw in the back associated with an axillary bubo, went on to necrosis, the black necrotic mass separated, leaving a deep ulcer with hard undermined edges, which finally granulated up and healed. Buboes seemed, in my experience, to be single or multiple in about equal proportions. On examination, tenderness in the groin or axilla is a valuable sign, and precedes the formation of a bubo; this tenderness is followed by fulness, with some surrounding oedema, and then the bubo forms. The flexed attitude of a limb may give a hint as to the possible site of the bubo, which is very tender on palpation.

(*d*) *Other signs of plague,* all very common, are vomiting, diarrhœa, a coated tongue, red at the edges, frontal headache, mental dulness, pain in the back, and injection of the conjunctivae, which is a valuable sign, the bloodshot eyes of the patient being very obvious to the most casual observer.

One of the great difficulties in conducting medical examination in natives, is their utter disregard for the truth. Whether they admit or deny having any symptom which the medical officer may mention, does not help him any further on in his investigation, unless this symptom is corroborated by some physical or other sign. One derives, therefore, no help from the patient, and any assistance he may offer may frequently prove to be merely put forward with a view to throw the examiner off the scent. Another difficulty is, that all questions put to the patient, in the great majority of instances, have to be put by an interpreter; and by the time the answer is delivered back to the examiner the answer he receives may have little to do with the question put, to say nothing of the time absorbed in the process. Even a knowledge of one native vernacular is not of much use in Madras, at any rate at Jalarpet; for frequently six or seven languages would be spoken by the different passengers in one train, though most had some acquaintance with Hindustani. Again, the physical con-

dition of the patient is always aggravated by the knowledge that he is being subjected to a more searching examination than his fellow-passengers; and this, if the patient is at all ill from any cause, may be sufficient to cause faintness and vomiting. There is a great fear of plague camps and plague officials among the natives.

During the ordinary routine medical examination of passengers, they are kept standing round the roped-in space in front of their carriage, until the examination of all is completed. The medical officer is followed round by clerks, who fill up the "intimation slip" of each passenger, already referred to. This sets forth the name, age, destination, address, and railway-ticket number, and is taken in duplicate by means of carbon-paper: one copy being retained for reference, and the other sent on to the passporting authority at the passenger's destination.

As each carriage is examined by the medical inspector, he detains a varying number on suspicion of plague: for disinfection if dirty, or for observation if the medical officer judges that they are not to be depended upon to observe the passport rules, or if their addresses are, in his opinion, insufficient. Certain classes, as pilgrims and others travelling in parties, are especially detained, as they frequently are dirty, and not proceeding to any fixed place of residence. The remaining passengers are, after this examination, and, intimation of their pending arrival secured, allowed to proceed upon their journey.

When a person is detained by reason of his fever, the filthiness of his person, or for other reason mentioned above, he is marched off to a roped-in space upon the platform, where his name, age, and address are taken (in case he absconds from the camp).

The detained batch of passengers are then marched off, under a police guard, to the disinfection camp. After disinfection, those who are merely detained for this purpose are liberated, and allowed to proceed on their journey, intimation of their departure being sent on their destination. The remainder are passed on to the observation camp to undergo observation, either for ten days or less, as judged necessary by the medical officer.

The legal powers of a Medical Inspector.—Considerable legal powers are invested in an inspecting medical officer. He may detain any train for as long as he thinks necessary for examination; he may require any person to alight and submit to examination as he (the medical officer) may direct, using such reasonable force as may

be necessary for this purpose, with the help of the police if required; he may detain any passenger in camp if he thinks there is suspicion of plague, or if there is a probability that he has recently suffered from plague, and so is in an infectious condition; or if he has been in recent contact with plague, or if he be judged to be otherwise "infectious," which is further defined to be anyone who is filthy, has filthy baggage, or anyone from an infected area. The medical officer may demand any particulars he thinks necessary from any passenger, such as his name, address, movements during the last fifteen days, or anything else he wishes; and the passenger is bound, under heavy penalties, to answer truly. If anyone is found to be travelling from an infected area, and is unable to satisfy the medical officer that he is proceeding to a fixed address, the passenger may be removed to the observation camp, and detained there for ten days, when he is permitted to depart if he shows no signs of plague. The penalty for any invasion or obstruction of the above regulations is, upon conviction, imprisonment with or without hard labour for a term not exceeding six months, or a fine not exceeding one thousand rupees, or both fine and imprisonment.

Every passenger is further bound to submit his railway ticket to the inspector, and to have it marked with the plague mark (for future passporting at his destination) if from an infected area. If he alights at a station short of an inspection station, whether his ticket is for that place or not, and if he appears to have done so to evade examination, or if he can show no competent business at that place, he is sent on, at his own expense, to the nearest inspection station by the station-master, or by the police, or plague official posted there for this purpose. This has been found to be a very necessary precaution to take, owing to the evasions, attempted or completed, in this way, so that native hospital assistants were posted at stations on each side of Jalarpet. Their duty was to question every person who alighted at such stations, and if their answers seem unsatisfactory, to send them on to Jalarpet. It is to be feared, however, that bribery entered somewhat into this arrangement; and that not only was merely a small sum necessary for the hospital assistant to be completely satisfied as to the justification of the passenger in alighting at that place, but also refusal of such a gift resulted in persons with legitimate business at that place being sent on to the inspection station, Be this as it may, some persons suffering plague, knowing that they could not

successfully pass the medical examination at Jalarpet, attempted to alight at adjoining stations, and were successfully detected and sent on, to be diagnosed as plague on inspection. Similarly, passengers, knowing of the futility of attempting to escape in this way, deferred their endeavour to escape until the train arrived at Jalarpet, when they were found hiding underneath the seats of the carriage suffering obviously from plague. It is of the greatest importance, therefore, to exercise supervision at stations adjacent to railway inspection stations; and this, coupled with the locking of all the carriage doors in the train at the previous stopping station, practically insures inspection of all passengers.

Disinfection of Railway Carriages.—Every carriage from which a plague case is removed is detached and disinfected at once under medical supervision. In the case of third-class carriages (which have no cushions, etc.), they are thoroughly washed with soft soap and lime-water. After an interval of two or three hours this is washed off with plain water, and the interior and exterior of the carriage is sprayed with a solution of—

Perchloride of mercury . .	oz. ½
Hydrochloric acid . .	oz. 1
Water . . .	gallons 3

This solution is directed into all the cracks and crevices, and the carriage is allowed to dry; when, after being left in the open air for forty-eight hours, it is afterwards brought again into use. In the case of first and second-class carriages, which afford greater facilities for harbouring the bacilli of plague, the cushions are burnt and the woodwork treated as above. The carriage is then re-painted and upholstered again.

Methods of attempted evasion of examination by railway passengers.—These methods are numerous, and in many instances highly ingenious.

The obvious question that first suggested itself to the subtile oriental mind was, why be inspected at all. Accordingly, tickets were purchased for stations short of the examining station, as has been already detailed, the passenger intending to proceed a few miles by road, and to rejoin the railway at some station beyond the inspecting station. I have have already mentioned that this plan was defeated by posting plague officials at these stations, and exercising supervision over passengers who attempted to alight there. Others did not attempt to leave the station they illegiti-

mately alighted at, but had carried out the plan of booking to this station, itself not infected, from some highly-infected locality, and, by purchasing a fresh ticket, to pose as travellers from a healthy locality. This was frustrated by instructing the booking-clerk and the plague officer to see that such passengers' fresh tickets were endorsed "plague-rebooked." They were then received at Jalarpet by the medical officer, and suitably dealt with on their real merits. As has been already said, some passengers suffering from plague were found concealed under the seat of the carriage; and occasionally it was necessary for the medical officer to head a storming party of police to dislodge a refractory passenger who refused to alight, the police objecting to storm the position unless led by the medical officer.

Another plan was to obtain, presumably by purchase, a certificate from some native official that he, the passenger, was in good health, and that he was travelling from a non-infected village in an officially plague-infected area. Beyond the wording of the certificate there was no possible proof that this was so, and the certificate had to be disregarded. This applies solely to manuscript certificates; many produced official certificates, which were of course genuine.

To avoid detention at Jalarpet, a very common plan was to arrange that a telegram should be sent to the traveller the day before he intended to start his journey, saying: "Your wife (son, mother, etc., as would seem most appropriate) died to-day; come at once." (This same plan is employed by Sepoys, anxious to obtain leave, or an extension of leave.) Other passengers were found to be travelling with borrowed or bought inoculation certificates,* as shown by the non-correspondence between the left thumb of the passenger and its supposed imprint on the certificate. Some of these persons were prosecuted and convicted, the usual fine being ten rupees. Among the more legitimate methods of attempting to avoid detention at Jalarpet, was that of being inoculated the day before starting on the journey. It is known to the natives that the inoculated are granted the privileges of exemption from detention unless they are suspected of actual plague; or they are detained merely for disinfection; and they are not required to take out a passport. This plan for evasion frequently defeated itself, since the usual inoculation fever, which persists for a day or two, caused suspicion that plague might be developing. Others put on new clothes to travel in, and in other ways

* For information as to inoculation certificates, see p. 84.

made themselves clean and respectable-looking; while others got themselves officially disinfected by the local authorities at their starting-point, and obtained a certificate to that effect. These endeavours were, when possible, rewarded by allowing the passenger to proceed on his journey, unless suspicious symptoms of plague were present. There is no doubt that many evasions by the above-known—and probably by many unknown—ways were successful.

The number of railway passengers examined and detained.—It is impossible to give accurately the exact number of persons medically examined at the Jalarpet railway inspection station. In checking the numbers for one month, I found the daily average for this period was 830. The inspection station was opened on August 20th, 1898, and at first only trains from Bangalore were inspected; latterly, as plague spread, other trains were added to the list. From August 1898 to July 1899, when plague prevalence had practically ceased for the time within about one hundred miles of Jalarpet, the estimated number of persons examined was 225,000. The actual number of detentions during this period amounted in round numbers to 11,500. The actual number of persons removed from trains, and whose illness was diagnosed at the time or afterwards as bubonic plague, was only 66. The percentage of passengers detained was, therefore, 5.11 ; and out of nearly a quarter million persons examined, only .03 per cent. had plague ; or of the 11,500 detained only .57 per cent. were infected.

These results may be tabulated as follows:—

Number of Passengers Examined.	Number Detained.	Number of Plague Cases.	Percentage of Passengers Detained.	Percentage of Plague among all Passengers.	Percentage of Plague among Detained Passengers.
225,000	11,500	66	5.11	.03	.57

The percentages expressed in this Table have to be corrected to some extent, for whereas all the detained persons were from infected areas, only some two-thirds of those examined came from such places. The percentage of plague cases among passengers from infected areas is estimated to be about ·045, and the percentage of passengers detained from infected areas would be about 8 per cent. The number of actual plague cases discovered among the travellers is small when it is remembered that many of the passengers

came from Bangalore, and from the Kolar Gold Fields, where plague was raging with great severity among the coolies employed there.

The utility of train inspection.—Although only some 8 per cent. of those coming from infected areas were detained for observation or disinfection, these included a very considerable proportion of passengers from highly-infected places, in contradistinction to passengers from areas merely declared "infected" officially. It is against these specially infected places that plague measures by detention are chiefly directed. All dirty persons, and those who do not appear trustworthy, are detained in observation camps; those who are "suspicious," by reason of fever, etc., forming only a small proportion of detentions. It is probably sufficient to inspect and passport all persons from ordinary infected areas, but against these highly infected places stronger measures are desirable; and every person who does not seem trustworthy enough to be given a passport should be detained for observation for the usual period, and liberated on its completion.

On the question of disinfection of railway passengers, the principal at any rate is sound; but when we consider the method employed in the majority of disinfection stations in India, its utility is, I think, open to question. The usual procedure is to strip the passenger, and to give him a cloth to wrap round his loins. His clothes and luggage are then disinfected by steam, a thorough and satisfactory method. There are usually articles in his baggage that would not stand this disinfection, so are exposed to the sun for an hour or so. The passenger himself is conducted to a bathing-shed, and a gallon or so of corrosive sublimate (1—10,000) is poured over him as he squats on the ground, leaving much of his body untouched; and the momentary contact of the disinfecting fluid can do little if anything to the parts of the body it does succeed in reaching. The passenger then receives back his clothes, and he is considered to be disinfected. He, on discharge, proceeds on his journey in a carriage that has not been disinfected, his fellow-passengers are possibly contaminated, and his own skin and hair are practically in the same condition in which they were before the passenger was detained. The disinfection of railway rolling stock is an impossibility on the large scale, though carriages which have contained cases diagnosed as plague are thoroughly dealt with in the way previously described.

The sole good this disinfection does is to sterilise the

clothes of the passenger, and this is no doubt very beneficial; but it is unsatisfactory to leave his skin, his boxes, his fellow-passengers probably, and his railway compartment untouched. If the clothes of every passenger were disinfected, more could be put forward in its favour; but where only those which seem dirtiest are dealt with, the value of the disinfection as at present practised is doubtful, considering the expense and inconvenience it occasions.

As regards the value of train inspection as a plague measure, the instance of Bangalore may be quoted. Some time before plague reached Bangalore, all passengers entering the place by the several lines of railway serving it were medically inspected. Several seriously infected towns in the Bombay Presidency, such as Poona, Hubli, Dharwar, Belgaum and Sholapur, were connected with it by rail. Suspicious cases were detained for observation, and the remaining passengers were escorted to their homes by police, to be further observed there for ten days by the plague authorities: a system which is considered by the Bangalore authorities to be more satisfactory than that of passporting. Plague did attack Bangalore in spite of these precautions, and in the city and cantonments, with a population of 180,000 (including 15,000 of a military population, who were little attacked), caused upwards of 10,000 deaths between September 1898, and March 1899. It has been conclusively proved that Bangalore was infected by railway, though the city and cantonment—the former under the government of the Mysore State and the latter under British rule—were infected from different sources.

The first case that occurred in the cantonment was the servant of a railway superintendent, who had just returned with his master from Hubli.

The first cases that appeared in the city were on the day following the occurrence of the above-named case, all among coolies working in the railway trans-shipping goods sheds of the Southern Mahratta Railway, and the disease was confined to these coolies and their friends for some time. The first infected houses were closely grouped round these goods sheds. Though the method of conveyance of infection is doubtful—for it might be brought by railway passengers, infected clothes, goods, or rats—it would seem most probable that passenger traffic is to be absolved from the charge, seeing that none of the passenger staff were attacked, and all those who contracted the disease were engaged in the goods department.

There are many means of communication between the

city and cantonment, and many common interests. In due course, the cantonment became infected by the occurrence of a second plague case—the first indigenous case—six weeks later. The disease then spread, appearing in many places simultaneously in city and cantonment, and got completely out of hand.

From the above facts, it would appear that railway passengers did not bring plague to Bangalore; and that the infection started, in some way or other—possibly connected with rats—in the railway goods sheds and surrounding property.

Mr. Cadell, I.C.S., in reporting on this outbreak,* considers that if any lesson is to be learnt from the results of plague measures, it is that the disease cannot be kept out of a place by railway, and still less by road inspections. Practically, the sole advantage he sees that they secure, is to prevent persons afflicted with plague travelling about the country; and looking to the few cases he considers have been thus detected, he doubts whether these examinations, with their attendant expense and the inconvenience they occasion to the travelling public—not to mention the blackmail levied by subordinates—are worth maintaining.

However, the fact still remains that plague has not spread to any appreciable extent in the Madras Presidency, those districts which were infected being closely grouped round infected districts in Mysore, Bombay and Hyderabad, with ninety-nine ways of access to a district in Madras for every one way that could be guarded by any less means than a complete cordon. Wherever access was by railway alone, distance putting other ways out of court, the disease has never got a foothold, and the few cases that occurred have been at once detected and isolated. The sanitary condition of towns in Madras is not sufficient to explain this immunity, for they are little, if any, better than many plague-infected towns in other parts of India.

Train inspection must always be associated with road inspection, to obtain the fullest benefit of the inspection system, for it is useless to impose restrictions upon passengers by train, and to allow at the same time travellers to pass freely about the country by road. With efficient railway and road inspection, and complete passporting of travellers, detaining the suspicious and those who appear untrustworthy, plague can best be kept under control, as far as the carriage of infection by travellers goes. Road

* "Report on the Outbreak of Plague in Bangalore, 1898-99," by Mr. P. R. Cadell.

inspection in India has not been thorough ; the staff are in many places corruptible, and some of the posts are ill-chosen. It is almost impossible to make a complete examination of each traveller, though this could be much better done than it has been in the past. The inspection and passporting of railway passengers, on the other hand, has been on the whole well done, and has achieved much for the salvation of the Presidency of Madras. Without the further co-operation of the people it is doubtful whether we can do more than has been done, attending to the points noted, and insisting upon their strict observance.

(5) The Passport System.

Every traveller from an infected area, who has not been already under surveillance in an observation camp, is given a passport on arrival at his destination. If a railway passenger, the passport issuing authority (who may be the station-master or a specially-appointed official), sees from the plague-punch on the ticket that the passenger comes from an infected area. The passenger then is given a passport binding him to appear daily for ten days at an appointed place, under a penalty, the maximum of which is imprisonment for six months and a fine of Rs. 1000. The passport, a copy of which is appended, contains particulars of the traveller's name, age, address, and so forth, and is signed by him. At the end of ten days it is received from the passport holder, and sent to the district plague office, where, from the dates and signatures of the examining officer, it is seen that the passenger has been regularly and duly observed. The issue of passports is further checked by the "intimation slips" taken at some railway inspection stations, and sent on to the traveller's destination. The number of persons who give false addresses, in the hope of escaping observation, varies from 3 to 10 per cent. in different districts. This was accurately checked for a period of three months in the Salem district of the Madras Presidency, and found to be 3.4 per cent.

The Bangalore authorities claim to have done away with the difficulty of untraceable persons, by escorting all native passengers who arrive there to their homes, under a police escort, these passengers being then observed daily for ten days.

The form of passport used in the city of Madras is appended, and this is used with slight modifications throughout the entire Presidency.

A.

(To be retained by the officer issuing the passport.)

1. No. of passport.
2. Date of issue.
3. Name of traveller.
4. Place of destination.
5. When the duplicate of the passport sent, and to whom.

Initials of officer issuing passport.

B.

Passport No. **Original.**

(To be issued to a person arriving from a plague-infected locality, or any notified area, under Regulation 22 under the Epidemic Diseases Act published in the "Fort St. George Gazette," Part I-A, dated April 11, 1899, page 137.

1. District.
2. Station of issue.
3. Date of arrival.
4. Name of person.
5. Father's name.
6. Caste.
7. Age.
8. Whence coming.
9. Destination and residence during the next ten days (give District, Taluk, Village, Street, and Number or Name of the owner of the house).

I declare the above information to be correct, and I do hereby bind myself $\frac{\text{to appear}}{\text{to present}}$ the above mentioned person for inspection, daily, for a period of ten days from this

Date Signature or mark of traveller.

Declared and signed before me.
Signature and designation of the officer
Date issuing the passport.

C.

Passport No. **Duplicate.**

(To be sent forthwith to the officer appointed to conduct the ten days' inspection.)

1. District.
2. Station of issue.
3. Date of arrival.
4. Name of person.
5. Father's name.
6. Caste.
7. Age.
8. Whence coming.
9. Destination and residence during the next ten days (give District, Taluk, Village, Street, and Number or Name of the house).

I declare the above information to be correct, and I do hereby bind myself $\frac{\text{to appear}}{\text{to present}}$ the above-mentioned person for inspection, daily, for a period of ten days from this date before_____

Date Signature or mark of traveller.

Declared and signed before me.
Signature and designation of officer
Date issuing the passport.

(*Reverse.*)

C.

Instructions to the officers appointed to conduct the ten days' inspection.

1. The officer shall daily inspect the passenger, and initial the original passport in token of the inspection.

2. He shall daily ascertain from the passenger whether there is any sickness or death in the house in which he is or has been residing. If the passenger is found to exhibit any symptoms of plague, or if any sickness or death is reported in his house, or if the passenger does not appear for examination on any day, the fact should be immediately reported to the President or the Health Officer of the Municipality.

3. If the passenger intimates, or it is otherwise known, that he desires to leave Madras within the period of ten days, the particulars of his future residence should be obtained and the fact communicated without delay to the local authority of the place of the new residence. The officer before whom the passenger must present himself for inspection at the new place of residence should be entered in the passport. Intimation of departure to any Railway Station in the province of Mysore should be telegraphed to the—

(*a*) Assistant Surgeon on plague duty, Yesvantpur, when the destination is a station on the Mysore State Railway;

B.

Endorsement of the Inspecting Officer.

Date	Signature	Designation
1st day		
2nd „		
3rd „		
4th „		
5th „		
6th „		
7th „		
8th „		
9th „		
10th „		

Forwarded to the President, Municipal Commission, Madras, the passenger having been duly inspected.

Date Signature and Designation of the Examining Officer.

A.

Regulation 22 under the Epidemic Diseases Act, published in the "Fort St. George Gazette," Part I-A, dated April 11, 1899, page 137.

City Regulation 22.—Every person arriving, or suspected of having arrived, from any place declared to be infected with plague, or from any place notified by His Excellency the Governor of Fort St. George in Council for the purposes of this regulation, shall, unless exempted under Regulation 21, be bound to appear at a place provided for the purpose, and obtain a passport binding him to present himself daily for inspection for a period of ten days before the officer

(b) Residency Surgeon, Bangalore, when the destination is a station within Mysore Province on the Madras Railway.

4. The inspecting officer should maintain a register in the following form :—

(1) Date of receipt of intimation.
(2) Name of traveller.
(3) From what infected area arriving.
(4) Date of arrival of traveller.
(5) Number, date and place of issue of passport.
(6) How long kept under observation.
(7) State of health of the traveller and other persons living in the house in which he is or has been residing.
(8) Date of departure if occurring within ten days.
(9) Destination.
(10) Date of intimation of departure to the local authority of the place of destination.
(11) Date of despatch of the passport to the President, Municipal Commission, Madras.

named in the passport, and he shall be bound so to present himself. On the expiry of ten days, the passport-holder shall deliver up his passport to the inspecting officer for transmission to the President, Municipal Commission, Madras. In case he has to leave Madras City within ten days from the date of his arrival, he shall forthwith give intimation to the inspecting officer, who shall report the fact to the local authority* of the new place of residence, and enter in the passport the name of the officer before whom the passenger must present himself at the new place of residence, and the passenger shall be bound to present himself accordingly.

Provided that, when it appears desirable, the President, Municipal Commission, Madras, or the Health Officer may, by endorsement on the passport, exempt any person from personal attendance and permit him to be inspected at his residence.

In the case of minors and incapacitated persons, the obligation to take out passports for them, to present them for daily inspection, to report truly their names and addresses, to intimate any changes in their residence, and to comply otherwise with the requirements of this regulation, shall vest in their legal guardians or persons in whose charge they travel, or who receive them at the railway station of destination.

N.B.—Any person disobeying or evading the above or any other Plague Regulation, or any order made in pursuance thereof, renders himself liable to prosecution for an offence punishable under section 188 of the Indian Penal Code, with imprisonment of either description for a term which may extend to six months, or fine which may extend to Rs. 1,000 or both.

* *Vide* Mufassal Regulation 17 (i), published in the *Fort St. George Gazette*, dated April 11, 1899, Part I-A, page 139.

(6) Inoculation.

When the Presidency of Madras was first threatened by plague, the value of inoculation by Haffkine's prophylactic was not so generally accepted as it is now. The Government, in drawing up plague regulations, hoped that it would prove valuable, but expressed at the time a somewhat guarded opinion about it. Every facility was afforded, however, for inoculation, and inoculators were appointed who endeavoured to persuade the people to come forward. No person was inoculated without his express consent. In many native regiments, the British officers were publicly inoculated at the head of their regiments, to inspire confidence in their Sepoys, who generally followed to a man the excellent lead given them by their officers.

In many localities the people hung back until the outbreak assumed formidable proportions, and then came forward in large numbers. Inoculators were warned against operating upon persons suffering from fever, but many persons in a late stage of incubation, or even early in the stage of invasion, came forward and were inoculated, to be attacked by plague in a day or two.

The early symptoms following inoculation are sensations of chilliness, headache, increased pulse and temperature, and general feeling of malaise, after about six hours. These symptoms increase, and persist for two or three days. Vomiting and diarrhœa may occur, and though the temperature does not usually exceed 102°, in some cases it rises higher. The local signs are inflammatory infiltration, which causes great tenderness, but very rarely suppuration. There is occasional desquamation over the inflamed area. The local and general symptoms may be comparatively trivial or very severe. The usual health is regained in from four to eight days, but the local tenderness and swelling may persist some days later.

The following rare symptoms after inoculation may be quoted:

"Joint pains	"Loss of appetite
"Erythema	"Constipation
"Urticaria	"Mental excitement
"Anæmia	"Feeling of unrest
"Emaciation	"Confusion of ideas
"General weakness	"Clammy taste in the mouth
"Dry cough	"Sexual excitement

"Asthma and chronic eczematous conditions are said to be alleviated by inoculation.

"The following symptoms of plague have no representatives in those following inoculation :—

"1. Enlargement of glands
"2. Blebs and sloughs
"3. Lobar pneumonia."

Certain privileges are conferred upon holders of inoculation certificates, who are exempted from taking out passports, or from detention in an observation camp, unless suspected of suffering from plague. They have, however, to be examined, and may be detained for disinfection if they or their luggage are dirty, or otherwise in a condition that merits disinfection. Moreover, they have to evacuate their houses, as others have to do, should a case of plague occur in it.

It is a fairly common plan, as has been already stated, for a native to be inoculated a day or so before travelling; being under the impression that, if inoculated, his chance of detention would be small. An inoculation certificate, however, is only valid from the 10th day after the operation till it is six months' old. The freshly-inoculated person, therefore, finds himself not only with a certificate not yet valid, but with fever, the result of inoculation. It is the rule for all fever cases to be detained, until, after observation, the condition is diagnosed as not due to plague. The traveller who had recently undergone inoculation found himself invariably—much to his own surprise—detained in an observation camp.

A common method of evasion is to obtain an inoculation certificate by loan or purchase, and to attempt to pass it off as the certificate of the passenger. The value of the imprint of the left thumb-mark of the holder, taken at the time of inoculation by the operator, is very great; and by this means many attempted evasions of this nature were detected, and the offenders prosecuted and convicted.*

* The system of identification by thumb mark is largely used in India for Government pensioners and the like, and is an almost certain test of identity. The three great divisions of patterns of the skin of the distal phalanx of the finger are the *arch*, the *loop* and the *whorl*. These may point in various directions and may be modified in various ways, so that it is usually a simple matter to recognise the print as a true pattern of the thumb, the left one being always selected. The difficulties in the system are, that (1) the patterns of some coolies are much worn away by hard work and give bad imprints, and in many cases quite unrecognisable ones; (2) the thumb impression may be badly taken by the inoculator. It is generally unnecessary to take a print of the thumb to satisfy oneself that the traveller is the genuine holder of the certificate; but if in doubt it is merely a matter of two or three minutes to take an impression and then to compare it with that in the certificate, a lens being of considerable use for this purpose.

The following rules for inoculations have been drawn up by Major Bannerman, I.M.S. (G.O. $\frac{876}{P}$ 12/6/99 Government of Madras, Local and Municipal).

1. A certificate may be granted after one full dose has been given, but the recipient should be recommended to return for a second inoculation after ten days.
2. The full dose should always be given at one time, unless for medical reasons it is considered advisable to divide it. If it is necessary to do this, a certificate should not be given until the equivalent of two full doses has been given. If, however, no undue reaction ensues after the first fractional dose has been taken, it is advisable to give the full dose at once on the second occasion, after which a certificate may be given.

The form of inoculation certificate approved by the Government of Madras is appended.

PLAGUE.

No. B **5544.**

Name

Father's name

Street
Village

Town
Taluk

District

Date

Initials of operator

No. B **5544**

INOCULATION CERTIFICATE.

CERTIFIED that

father's name

resident of Street / Village' Town / Taluk'

District has been inoculated by me, and that his thumb-mark was at the time impressed before me.

Space for left thumb-mark.

Signature and designation.

Dated 189 .

Note.—Unless suffering from, or suspected to be suffering from plague, the holder of the certificate is exempted from segregation, from detention when travelling, and from ten days' observation under the passport rules. It does not, however, exempt him from liability to evacuate an infected house, except in the case where all the occupants of the house have been inoculated, or have his clothes disinfected when travelling. The certificate is valid for a period of six months.

(7) The Prosecution of Measures of Sanitary Reform.

Plague, as is well known, is frequently found associated with grave insanitary conditions; it becomes, therefore, the duty of all sanitary authorities to make special efforts to remove all such conditions as are favourable to the spread of the disease.

The abatement of nuisances such as accumulations of filth, and overcrowding, absence of light and ventilation, have all to be dealt with, and particularly dampness; the latter of which, according to Lieut.-Col. George Waters, I.M.S. (see *The Medical Magazine*, February and March, 1899), is the great factor in the spread of plague. Colonel Waters was in medical charge of two jails and a large school in the city of Bombay. The school, with 250 pupils, was situated in the midst of a severely plague-stricken area, and was the only institution of its kind to escape infection, except for two cases in 1896 and 1897. One of the jails was also kept dry and escaped infection. The other was so permeated with water from leaky pipes, as to defy all efforts towards the maintenance of dryness. Plague raged until the water was cut off. In six days the premises became dry and plague ceased, after the occurrence of thirty-four cases and seventeen deaths out of a jail population of three hundred. The disease did not decrease gradually, but suddenly, unlike the normal subsidence of a plague epidemic, for the last feature of the outbreak was six simultaneous seizures. Colonel Waters ascribes the immunity of Europeans as being mainly due to their dry environment. The above experience illustrates the importance of maintaining dryness.

Returns of sickness and mortality have to be attended to. At present these are very inaccurately maintained, there being no general notification of infectious disease; registration, too, of deaths is very imperfect. The inspection of corpses is repugnant to the feelings of the Indian people, and is condemned by the Government of Madras, who doubt its practical value, though it has been largely practised in some parts of India during plague epidemics.

Until the public health organisation of India is put upon a proper footing, no great sanitary improvements or reforms can be expected. The majority of municipalities themselves cannot afford to adequately pay a health officer. Besides plague, there are other preventible diseases which

are causing a high mortality in India, and the need of trained sanitarians is everywhere great, and this urgent need deserves the earnest consideration of the Government. There are grounds for hoping that some recommendations in this direction may be contained in the report about to be issued by the Plague Commission, of which Professor T R. Fraser, M.D., F.R.S., is the chairman.

THE UTILITY OF BACTERIOLOGICAL EXAMINATION IN A DIPHTHERIA EPIDEMIC IN A SCHOOL.

WITH

SPECIAL REFERENCE TO THE DIPHTHERIA IN THE POPLAR UNION SCHOOLS AT FOREST GATE, IN 1898-1899.

By KENNETH W. GOADBY,
Bacteriological Laboratory, Guy's Hospital.

(*Read: January 19th*, 1900.)

In January 1899 I was called upon to make a bacteriological examination of the childrens' throats in the Poplar Union Schools at Forest Gate, where an epidemic of sore throat had culminated in an increasing number of cases of diphtheria. Before entering into the discussion of the epidemic, it will be as well to say a few words about the general health of the school for the half year preceding the outbreak of sore throat. It will be seen, on referring to the Report of the Medical Officer, Dr. Bell, that the health of the school as a whole was good during this period.

Scarlet Fever.—The number of children present at the school averages 600; they are housed in "Barrack Buildings." From March 1898 to October 1898 twenty-seven cases of scarlet fever occurred as follows:—

Boys ...	...	...	...	5
Girls ...	..	...	...	12
Infants	...	...	...	10
	Total	...	...	27

The source of the contagion was not traced in any of the cases. Between November 27th and December 31st, seventeen infants were removed with scarlet fever.

First Cases of Diphtheria.—On November 27th and 28th three girls were sent to the Eastern Fever Hospital with

diphtheria, and during December five boys and girls, making a total from November 27th to December 31st of eight cases of diphtheria.

Commencing on December 15th, an epidemic of sore throat, accompanied with a temperature of from 100 deg. F. to 100.8 deg. F. (lasting twenty-four to forty-eight hours), occurred, and affected some fifty children. No *sequelæ* followed. From December 20th to 30th, four of the officers were attacked in a similar manner, but had, in addition to the sore throat, rigours and pains in the back, head and legs. These cases, as well as those of the children, were classed as epidemic influenza.

There appears, then, to have been an outbreak of scarlet fever in the school, the latter part of which was co-existent with the commencement of the epidemic of sore throat. I shall refer to this point later.

At the latter end of December, owing to the increase in the number of cases of diphtheria, three children apparently suffering from tonsilitis were sent to the Eastern Fever Hospital for bacteriological diagnosis: all were reported to have diphtheria bacilli in their throats. Under these circumstances, Dr. Downes suggested that a bacteriological examination of the whole school would be of service; the matter was discussed, and strongly supported by the Medical Officer, with the result that an examination was decided upon, the Committee instructing me to that effect.

Description of Schools.—The schools at Forest Gate consist of a block of buildings, shaped in plan something like the letter E; the two outer limbs of the E correspond with the dormitories of the boys and girls, the schoolrooms and offices occupying the ground floor. The centre limb of the E is the dining hall (and the kitchens), the entrance for the respective sexes being situated at the opposite ends of the dining-hall. The reception wards, where new-comers are retained for fourteen days after admission before they mix with the general body of the school, are situated at the back of the main block of buildings on the left; whilst on the right is the infant block, consisting of schoolroom and dormitories for the infants. It may be as well here to define what is meant by an infant. By an infant, in the present paper, is meant a child of from three to seven years of age; after the age of seven the children are drafted into the general body of the school.

There is no covered communication connecting the reception wards of the infant block with the main building

of the school. The infirmary is situated to the left of the main building; there is no isolation hospital in the schools; and all cases sent from the three departments are accommodated in the infirmary. The amount of room is somewhat limited, and there are only two playing-rooms (one for each sex), where children can amuse themselves on wet days. Owing to this arrangement, any children sent from the school, who are not sufficiently ill to be confined to bed, mix freely with the others. In view of this unsatisfactory state of things, it is extremely difficult to isolate cases of infectious disease; and it is apparently quite possible for children sent over from the main body of the school suffering from infectious disease to infect others in the infirmary, who are convalescent and about to return to the school. As a matter of practice, the Medical Officer sends all suspected cases of diphtheria, or scarlet fever, etc., to the Fever Hospital at once. At the back of the buildings there is a considerable open space, consisting of a field and gardens: there are also two large yards at the side of the main building, each with a large dry shed for wet days.

The subsoil is that common to Essex, *i.e.*, London clay; there is, however, a certain amount of gravel overlying it.

Difficulty of Isolation.—Before commencing the examination of the children, I suggested to the School Committee, that those children who were found to have the diphtheria bacillus in their throats should be isolated from the rest of the school as the examination was proceeding, it being obviously impossible to examine the whole number at once. I therefore examined the infant block first, as giving better chance of temporary isolation, as well as affording information of the condition of the school generally. So many children in this part of the school were found to have the specific bacilli in their throats, that it was suggested that the healthy children should be sent away to some other place. Gore Farm was tried for, but was not available; and no other place being obtainable, it was determined to endeavour to isolate the children on the school premises.

Isolation for Night.—The examination was therefore conducted with this object in view, one hundred children being examined each day for a week, the results being communicated to the school authorities at once. The children found to have diphtheria bacilli in their throats were then taken from two dormitories and put into one; the healthy ones from the two being placed in the other one.

Day Isolation.—An attempt was also made to keep the two classes separate during the day. This provisional isolation, however, broke down, as on wet days there was only one common shed for the two classes to play in.

Dr. Goodall, who was consulted as to the best means of isolating the two classes of children, found the above condition on the day he visited the school.

Dr. Goodall suggested a plan of isolation, the best possible under the circumstances, which was carried out at once; but, unfortunately, up to the time it was put into effect, the isolation for ten days had been nothing more than suspending all indoor gatherings of the children, and the attempt to keep the children apart on dry days.

The plan of isolation suggested by Dr. Goodall was at the best only a relative one, owing to the structural difficulties of the school buildings, there being many intercommunicating passages; and further to the fact that for ten day days after the bacteriological examination had been made, the children had been freely mixing; nevertheless, after the isolation was made, the sore throats practically ceased, but a certain number of cases of clinical diphtheria continued to occur. I shall return to this subject later.

The examination was commenced on January 21st, and during the following week the whole of the school was gone over. The total number of children present in the school at the time of the examination was 586, the number being made up of the following units:—

Boys	... ...	297
Girls	... ...	200
Infants	... ...	89
	Total ...	586

(infants are children of three to seven years of age).

Method of Examination.—The method in which the examination was conducted was as follows: The children were drawn up in rows, in the order already written in the note-book, each child in turn passing up to the examiner. I found that this method of having all the children together prevented them from fearing the process, besides being much quicker. It is gratifying to say not one of the whole number gave the least trouble, or indulged in tears.

Sterile swabs of cotton wool on iron wire were used to obtain the culture from the throats, and coagulated blood serum used as the culture medium. Each tube was inoculated at once, and then handed to an assistant, who numbered the tubes with the number corresponding to each child in the note-book. At the same time that the culture was taken from the throats the following clinical points were noted, and the children divided into four classes.

Clinical Points Noted:

(*a*) Inflamed or congested condition of mucous membrane.
(*b*) Swollen or enlarged tonsils, with post-nasal growths.
(*c*) Exudation on fauces or soft palate.
(*d*) Healthy throats.

A letter corresponding to the condition observed was entered in the note-book against each child.

I found no difficulty in examining the condition of the throats, as by gently passing the swab over the dorsum of the tongue, and so touching the pharangeal wall, a clear view of the whole of the fauces, etc., was obtained; and at the same time, by a rapid movement, the swab was passed over any suspicious areas. The cultivations were taken to the laboratory and placed in the incubator at once. At the end of twenty-four hours, coverslip preparations were made from each tube. The macroscopic appearance of the colonies was noted as well.

In dealing with so large a number of cultivations, it was obviously impossible to examine each coverslip preparation directly it was made; the slips were accordingly mounted at once and numbered with the child's number. In this way I was enabled to have all the coverslip preparations of the same cultural age, a matter of not a little importance. The whole of the observations, staining, and cultivations, were made by myself, thus avoiding the introduction of another personal equation.

In examining the cultures, note was kept of the other organisms found, and many interesting points were observed, among others, the presence of the Cladothricae* was observed, to which I have referred elsewhere.

In almost every case I also noted the presence of cocci, many of which were subsequently isolated and examined.

* *Trans. Odontological Society*, June 1899.

The stains were: carbolic, methylene blue, Neisser's stain. MacConkeys' capsule stain was also used as a variant; but the diphtheria bacillus was always determined from the methylene blue specimens.

When any doubt arose as to the identity of a given specimen, subcultivations were made on the usual laboratory media. Owing to the large number of cultivations, it was impossible to make inoculation experiments with all. Two inoculations were made only. I have therefore relied entirely upon the microscopical appearance of the colonies, and more largely upon the microscopical examination of the morphology of the organisms.

Definition of Diphtheria Bacillus.—The organisms which I have called B. Diphtheriæ in the present paper are of two distinct morphological varieties:—

(*a*) B. Diphtheriæ.
(*b*) B. Diphtheriæ var. "sheath."

(*a*) B. Diphtheriæ straight or slightly curved rods, often to be found with swollen or clubbed ends. A twenty-four hour culture generally shows some segmentation and partial staining of protoplasm. This partial staining is well shown in specimens stained by Neisser's method. The arrangement of the bacilli in the field is generally irregular.

(*b*) B. Diphtheriæ var. "sheath" straight or slightly curved rods tapering at either end; the central part of the organism takes the stain best. The central portion is generally lozenge-shaped, or two small triangles with their bases applied.

Both forms often show considerable metachromatism.

Definition of B. Hoffmann.—The organisms called B. Hoffmann have been separated from the B. Diphtheriæ morphologically as follows:—

B. Hoffmann.—Short rod-shaped or pyramidal organism, arranged in pairs with the bases in apposition, the pairs of ten arranged in parallel masses, the bacillus stains throughout with methylene blue. Metachromatism rarely occurs.

I have adopted the morphology as given by Eyre, in the *Annual of Microscopy*, and by Washbourn and Garratt in *British Medical Journal*, April 6, 1892.

Special Terms.—There are still two terms that require to be defined before proceeding with the discussion of the epidemic. They are those applied to the children in whose throats the B. Diphtheriæ was found, and those in which no Klebs Lœffler bacilli were found. The two terms appear in the reports made to the school committee, and for that reason have been retained. Microbics, Amicrobics; the former term corresponding to the German "bacillustragende," the latter to the children in whose throats no diphtheria bacilli were found.

The question that naturally suggests itself at the outset of this paper is, of what practical value is a systematic examination of the children of an infected school, and does such an examination help in the eradication of the infection? The following results will, I think, give an affirmative answer.

The result of the examination, conducted in the manner set forth above, gave the following numbers of microbics:—

Boys	66
Girls	85
Infants	39
Total	190

Children who gave cultivations of B. Hoffmann:

Boys	50
Girls	37
Infants	12
Total of Hoffmann children ...	99

From which we see that—

190 children gave cultures of B. Diphtheriæ.
99 children gave cultures of B. Hoffmann.
227 children gave no culture of Diphtheriæ or Hoffmann.

Total, 586 children examined in the school.

The percentage occurrence of B. Diphtheriæ and Hoffmann for the school was as follows:

B. Diphtheriæ	...	34.1 per cent.
B. Hoffmann	...	16.9 „

Percentage occurrence of B. Diphtheriæ plus B. Hoffmann, 47.6 per cent.

Meade Bolton* say that of 214 healthy persons who had at some time been exposed to infection, 45.5 per cent. showed Klebs-Loeffler bacilli in their throats. Park and Beebe† examined the throats of forty-eight children, apparently in good health, in fourteen families in which diphtheria was present, and in 50 per cent. found the B. diphtheriæ. Muller‡ examined bacteriologically one hundred children in the general wards of the Charité in Berlin; of these six on entry had the bacillus in their throats without exhibiting any symptoms of the disease. Two days after, the bacillus had infected fourteen others.

Most observers seem to agree that of all persons exposed to infection by diphtheria about 33 per cent. get the bacillus in their throats. My own figures agree closely with those given by others, as will be seen on reference to the Tables. (See Tables I to III.)

I referred above to the fact that the number of sore throats practically ceased when the isolation was carried into effect, and I wish again to refer to this.

TABLE I.—*Microbics of January Examination, examined March 6th.*

——	Number Examined.	K. L. B.	Hoffmann.	Negative.
Boys	18	13	0	5
Girls	20	12	3	5
Infants	10	4	4	2
Totals ...	48	29	7	12

K. L. B. = 60.4 per cent.
Hoffmann = 14.5 „
K. L. B. + Hof. = 75 „

* *Med. and Surg. Reporter*, vol. lxxiv, 1896, p. 799.
† *New York Med. Record*, vol. xlvi, 1894, p. 396.
‡ *Jahrbuch fur Kindebeilkunde*, B. xiii, 1896, Heft 1.

TABLE II.—*Amicrobics of January Examination, examined March 21st.*

——	Number Examined.	K. L. B.	Hoffmann.	Negative.
Boys	20	4	3	13
Girls	20	6	5	9
Infants	10	5	0	5
Totals ...	50	15	8	27

K. L. B. = 30 per cent.
Hoffmann = 16 „
K. L. B. + Hoffmann = 46 „

TABLE III.—*Showing Infection after Mixing the two Classes of Children. Sample taken ten days after Mixing, (eighteen Children Examined March 21st, and found to be free from K. L. B.).*

——	Number Examined.	K. L. B.	Hoffmann.	Negative.
Boys	9	3	1	5
Girls	9	3	2	4
Totals ...	18	6	3	9

K. L. B. = 33.3 per cent.
Hoffmann = 16.6 „
K. L. B. + Hoffmann = 50 „

Sore Throats.—The occurrence may be conveniently tabulated thus:

From December 1st, 1898, to January 28th, fifty cases of sore throat occurred.

On January 28th the isolation was commenced.

From January 28th to March 6th, twelve cases of sore throat occurred.

From March 6th to April 2nd, nine cases of sore throat occurred.

On April 2nd the children were again mixed.

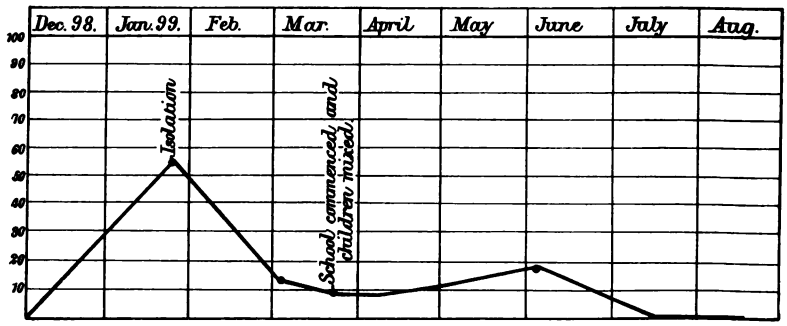
From April 2nd to June 21st, nineteen cases of sore throat occurred,

These numbers only refer to those children who were under treatment for sore throat, and do not include those who complained of sore throat, but in whom there was no sign of trouble. None of the above children had clinical diphtheria.

From the above Table it will be seen that after the isolation was commenced, the number of cases of sore throat diminished up to April 2nd, when the children of the two classes (microbic and amicrobic) were again mixed for the continuation of the ordinary school routine; from this date the number of cases increased for a time, eventually, however, disappearing.

The accompanying curve represents the sore throat incidence.

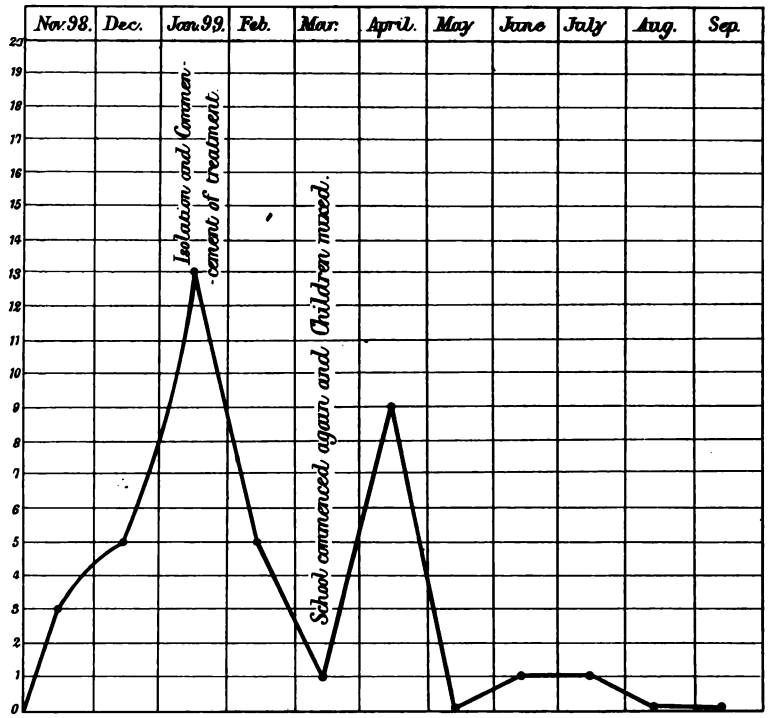
CURVE OF SORE THROAT INCIDENCE.



Clinical Diphtheria.—During the epidemic commencing on November 22nd, 26th, 28th, with three girls up to September, 1899, thirty-eight cases of clinical diphtheria occurred as follows:—

November	1899	...	3	cases of clinical diphtheria.	
December	„	...	5	„	„
January	„	...	13	„	„
February	„	...	5	„	„
March	„	...	1	„	„
April	„	...	9	„	„
May	„	...	0	„	„
June	„	...	1	„	„
July	„	...	1	„	„
August	„	...	0	„	„
September	„	...	0	„	„
Total cases of clinical diphtheria			38		

CURVE OF INCIDENCE OF CLINICAL DIPHTHERIA.



Of these children, thirty-eight in number, five cases occurred before examination was made.

Of the thirty-two cases occurring later—

15 = Microbics.
3 = Hoffmann.
14 = Amicrobics.

On referring to the two curves of sore throat and clinical diphtheria, we find the following:—

(*a*) That from the commencement of the epidemic up to the time that the isolation was put into operation, there was an increasing incidence of clinical diphtheria as well as increasing occurrence of sore throat.

(*b*) Immediately following the isolation of the microbic children, a well-marked fall of both case incidence and sore throat occurred.

(*c*) That when the two classes of children were again mixed, a rise occurs in both curves, most marked, however, in the case incidence.

We may, I think, safely conclude that the measures taken to combat the general condition of the school, revealed by the bacteriological examination, were responsible for the improvement, as shown by the curves. Further, I think that had it been possible to isolate the children as the examination was proceeding, a still better result would have been obtained.

It is, I believe, a generally accepted fact that a healthy child may become infected with diphtheria of a severe, nay, mortal character, by another child, who, although apparently healthy, is carrying the diphtheria bacillus in its throat.

The late Sir Richard Thorne, in his Milroy lectures,* mentions several cases of this description: a large number of other observers might also be quoted (Parkes,† Newsholme,‡ Airy,§ Netter,¶ Williams and Foulerton,** &c.).

An incident of interest of the infection of healthy children occurred during the epidemic under discussion.

On February 11th, 20th, and March 9th, seven children who had been at the seaside for tuberculous glands, &c., were readmitted to the School, and were placed among the amicrobic class. Of these seven children three contracted diphtheria in a severe form, with anæmia, prostration and offensive nasal discharge, together with severe toxic symptoms. These three cases were the most severe that occurred in the whole epidemic. Careful inquiry at the home from which they had come elicited no information of any case of diphtheria, and it is in the highest degree probable that they contracted the disease at the School.

The three cases occurred thus:—

One child, admitted February 11th, was removed to Fever Hospital, February 22nd.

* *Diphtheria, Natural History and Prevention*, p. 57, etc.

† *Hygiene and Public Health*, p. 437.

‡ *Epidemic Diphtheria*, p. 138.

§ *Trans. Epidem. Soc.*, vol. iv, 1875-80.

¶ *Bull. de la Soc. Med. des Hôp.*, 1896.

** *Lancet*, Oct. 23rd, 1897, p. 1038.

One child, admitted February 20th, was removed to Fever Hospital, February 25th.
One child, admitted March 9th, was removed to Fever Hospital, March 17th.

I have stated above that it was obviously impossible to make inoculation experiments with the whole of the cultures of diphtheria obtained from the throats. Two such inoculation experiments were, however, made for me by Dr. Eyre. Both the cultivations were from children who had no clinical signs of throat affection, and had also never complained of sore throat.

The following are the particulars of the experiments:—

Inoculation Experiments.—Culture A, Infant, Two milligrammes of a twenty-four hours' blood serum cultivation was inoculated subcutaneously into a guinea pig, weighing 403 grammes; death ensued sixty hours later. At the *post-mortem* examination, all the usual signs of infection by the diphtheria bacillus were found: gelatinous exudation from pubes to neck, haemorrhagic adrenals and kidneys, pleural and pericardial effusion. The bacilli were obtained in pure culture from the site of inoculation.

Culture B, Boy. Four milligrammes of a twenty-four hours' blood serum culture was inoculated subcutaneously into the loose abdominal tissue of a guinea pig weighing 400 grammes; death ensued forty-eight hours later. All the signs observed in guinea pig A were present, and the bacilli were obtained from the site of inoculation in pure culture.

The toxicity was also tested in the following way:—

Two broth cultures were made from A and B respectively, and, after seven days' incubation at 37.5 C., were filtered in the usual way

Guinea pig C was inoculated with $\frac{1}{5}$ cc. of filtrate A (weight = 581 gm.).
Guinea pig D was inoculated with $\frac{1}{10}$ cc. of filtrate B (weight = 180 gm.).

Forty-eight hours later C died, and at the *post-mortem* the usual signs were found; Guinea pig D was ill for two days, but recovered.

I have just mentioned the three cases of infection of healthy children, all of whom had been admitted into the amicrobic section. It must be remembered, however, that it was ten days after the examination that the isolation was put into force; the isolation up to this time being

confined to keeping the children out of doors as much as possible, and from mixing, as far as lay in the power of the masters. The three children did not come in contact with the microbic section during their brief stay.

Under these circumstances, it was decided to have a second examination of the amicrobics, and at the same time an examination of the microbic class, to determine if any improvement of their condition had taken place. The whole of the children were not examined, but a sampling was taken at random from the three divisions of the school (boys, girls, and infants). This method of sampling was suggested by Dr. Downes, and the results compare very favourably with the entire examination, although the figures cannot, of course, be quite so exact.

Second Examination.

Fifty children were examined in the method described above, and of these fifteen were found to have diphtheria bacilli in their throats. On January 28th, all these children were pronounced free from the specific bacillus, as far as a single examination can determine the fact. On March 21st, fifteen of then had become bacillustragende. On March 6th, forty-eight of the microbics were also examined, and twenty-nine of them found still to have the specific bacillus. Tables I and II give these numbers.

It will be seen from the Tables that the percentage in the supposed unaffected class was 30 per cent., or almost that of the whole school at the initial examination. The percentage of diphtheria plus Hoffmann have been given in all the Tables, on account of the division of opinion extant concerning the true identity of the two organisms.

Upon my reporting the large percentage of microbics in the supposed amicrobics, the School Committee decided that there would be little harm in again mixing the two sections of scholars, so that the ordinary school duties might be resumed, all school having been suspended from January 28th. This matter of school attendance is a matter of considerable practical bearing in dealing with epidemics in Poor Law schools; especially as it was decided at the outset of the epidemic that the children bacteriologically found to have diphtheria bacilli in their throats could not be certified as suffering from the disease, unless at the same time they exhibited clinical signs of the malady. Ten days

after the mixing took place, I again examined a sample of children, to determine if the mixing had any marked effect on the number of individuals with bacilli in their throats. Twenty children were examined, and eighteen of them had been examined on March 21st with a negative result; the other two had been examined in January, and were again returned microbic. Of the eighteen, six were returned as microbics; we may tabulate the result thus:—

Six children examined, January 21st, no K. L. B. found.
" " " March 21st " " "
" " " April 2nd, K. L. B. found in all.

Table III shows these figures.

From this we again have a percentage of about 33. This Table should be compared with the curve of incidence of clinical diphtheria and that of sore throat. It will be seen that—

(*a*) The rise in number of cases of true diphtheria,
(*b*) The rise in number of cases of sore throat,
(*c*) The increase in the number of bacillustragende,

all take place at the same time, a matter of considerable interest; for it would appear that here were all the factors for a severe epidemic, and yet the disease gradually declined, and there has not, so far (January 10th, 1900), been any recrudescence. I might call attention to the fact at this point that the summers 1898 and 1899 were dry summers. I have, however, no record of the rainfall for the early part of 1899 for Forest Gate.

Third and Fourth Examinations.

Further samplings of the school were taken at subsequent dates—one on June 21st, when ninety children were examined, and the last on September 29th, when fifty were examined. The results will be found in Table IV.

I also noted the persistence of the diphtheria bacillus, as shown from the various samplings; the results are set out in Tables V and VI, from which it appears that of eighty-four children examined who showed K. L. B. at the first examination, fourteen eventually showed B. Hoffmann; whilst of thirty-five children who showed B. Hoffmann at the first examination, eleven eventually showed K. L. B.

TABLE IV.—*Showing presence of B. Diphtheria and B. Hoffmann in the Forest Gate Schools at the various Examinations.*

No.	Date.	Children Examined.	B. Dip. present.	B. Hoffmann present.	Negative.	Per cent. K. L. B.	Per cent. Hoffmann.	Per cent. K. L. B. and Hoffmann.
1	Jan. 28	Whole School, 586	190	99	297	32.4	16.8	49.3
2	Mar. 6	Sample of Amicrobics, 48 ...	29	7	12	60.4	14.5	75
3	Mar. 21	Sample of Amicrobics, 50 ...	15	8	27	30	16	46
4	Apr. 2	Sample of Amicrobics after mixing, 20 ... Note. 2 = Microbics of No. 3	8	3	9	40	15	55
5	June 21	Sample, 90 ...	25	23	42	27.7	25.5	53.3
6	Sep. 29	Sample, 50 ...	15	11	24	30	22	52
		Seven of these were new children, and of them	3	2	2			
		Total 844	282	151	411	33.4	17.8	51.3

TABLE V.—*Showing B. Diphtheria at first Examination that eventually showed B. Hoffmann at the subsequent Examinations.*

Date of Examination.	Children Examined.	K. L. B. found.	B. Hoffmann found.	Negative.
March 6th ...	48	29	6	13
April 2nd ..	2	2	0	0
June 21st ...	20	5	5	10
September 29th	14	5	3	6
Total ...	84	41	14	29

TABLE VI.—*Showing B. Hoffmann at first Examination that eventually showed B. Diphtheria.*

Date of Examinatiun.	Children Examined.	K. L. B. Found.	B. Hoffmann Found.	Negative.
March 21st ...	11	4	3	4
April 2nd ...	6	3	1	2
June 21st ...	14	3	6	5
September 29th.	4	1	2	1
Total ...	35	11	12	12

PATHOLOGICAL CONDITIONS OF THROAT.

I have already stated that at the first examination I noted the general condition of the throats, and classed them into the following four classes:—

(*a*) Hyperæmia.
(*b*) Enlarged Tonsils.
(*c*) Exudation.
(*d*) Healthy Throats.

On examining the figures, several interesting relations are seen. In the first place, one is struck by the very large number of unhealthy throats in the infected school; and when this number is compared with the result of an examination of a school where no diphtheria had occurred for two years, it will be seen that the number is in excess of the normal, as shown by the healthy school. Thus, at the Forest Gate Schools the number of unhealthy throats was 458 out of 586, leaving only 128 healthy throats. At

TABLE VII.—*Showing the numbers of Children in Classes A, B, C, D, in the Forest Gate Schools.*

Number of Children in School.	Healthy Throats, Class D.	Unhealthy Throats.			
		Class A.	Class B.	Class C.	All Classes (A, B, C).
Boys, 297	59	83	138	17	238
Girls, 200	39	56	95	10	161
Infants, 89	30	22	29	8	59
Total, 586	128	161	262	35	458

TABLE VIII.—*Showing the number of B. Diphtheria and B. Hoffmann Children in Classes A, B, C, D at the first Examinations. Forest Gate School.*

Children Examined.	Number in the Classes.				Number of B. Dip. in Classes.				Number of B. Hoff. in Classes.			
	A	B	C	D	A	B	C	D	A	B	C	D
First Exam. 586	161	262	35	128	49	90	9	42	28	49	8	14

Therefore, of 128 children with healthy throats 42 showed B. Diphtheria = 32.8 per cent.

And also of 458 children with unhealthy throats 148 showed B. Diphtheria = 32.3 per cent.

Note also that :—

(i.) of 99 Hoffmann children 3 developed clinical diphtheria = 3 per cent.
(ii.) „ 190 Microbic „ 15 „ „ „ = 7.7 „
(iii.) „ 297 Amicrobic „ 14 „ „ „ = 4.7 „

There were no deaths.

TABLE IX.—*Showing Children of Class B. Examined with negative results at first Examination, and who subsequently showed K. L. B.*

Date of Examination.	No. Examined.	Total K. L. B. in Sample.	K. L. B. in Class B.	Fresh Cases, Total.	Fresh Cases, Class B.
March 21st ...	50	15	10	15	10
April 2nd ...	20	8	5	6	4
January 21st ...	90	25	9	20	6
September 28th.	50	15	8	10	6
Total ...	210	63	32	51	26

the other school, facilities for examining which were obtained for me by Dr. Downes, show, out of 100 children examined, 42 with unhealthy throats and 58 with healthy ones. The numbers in the various classes will be seen on reference to Tables X and XI.

TABLE X.—*Showing results of Examination of* 100 *Children in Barrack School, where no Diphtheria had occurred for Two Years.*

Children.	K.L.B.	Hoffmann.	Class A.	Class B.	Class C.	Class D.	K. L. B. in Classes.			
							A.	B.	C.	D.
Boys, 40	8	7	3	7	0	30	3	3	0	2
Girls, 40	8	5	5	15	0	20	2	4	0	2
Infants, 20	2	4	3	9	0	8	0	2	0	0
Totals 100	18	16	11	31	0	58	5	9	0	4

Therefore, of 58 children with healthy throats 4 showed B. Diphtheria = 6.8 per cent.

Therefore, of 42 children with unhealthy throats 14 showed B. Diphtheria = 35.7 per cent.

TABLE XI.—*Showing incidence of K. L. B. and Hoffmann B. in Barrack School, where no Diphtheria had occurred for two years.*

Children.	B. Hoffmann.				B. Diphtheriæ.				Total K. C. B. in Sample.	Total Hoffmann in Sample.
	A	B	C	D	A	B	C	D		
Boys, 40 ...	2	5	0	0	3	3	0	2	8	7
Girls, 40 ...	2	2	0	1	2	4	0	2	8	5
Infants, 20	1	3	0	0	0	2	0	0	2	4
Totals 100	5	10	0	1	5	9	0	4	18	16

The question that next arises is the relationship of the condition of the throat and the presence of the diphtheria bacillus.

Very many observers have pointed out the fact that faucial affections are predisposing causes of diphtheria: thus Thorne Thorne,* in summing up a large amount of circumstantial evidence, as well as clinical experience, says it is clear that in these cases of associated disease (diphtheria and scarlet fever) it is the scarlet fever that always takes the precedence of the diphtheria. Washbourn and Garratt† have further shown that the systematic exami-

* *Loc. cit.*, p. 70.

† *Brit. Med. Journ.*, April 15th, 1899.

nation of the throat of the patients admitted to the London Fever Hospital has reduced the number of cases of post-scarlatinal diphtheria to a vanishing point. Ranke,* Goodall,† Sverensen,‡ and Beggs§ have all shown the occurrence of diphtheria bacilli in the throats of scarlet fever patients. On the other hand, Hawkins, quoted by Thorne Thorne, states that during 1888-90 383 cases of diphtheria, 134 cases of scarlet fever, and 1,173 cases of other diseases were admitted into St. Thomas's Hospital, and in only one instance did diphtheria spread to any other patient. The balance of the evidence seems, however, to point to pathological conditions of the fauces predisposing largely to the presence of the diphtheria bacillus.

In connection with the question of scarlet fever, it is interesting to note that in the schools at Forest Gate an epidemic of scarlet fever actually immediately preceded the epidemic of diphtheria.

There is another relation brought out in the Tables given, namely, the large percentage of children of Class B (enlarged tonsils) who were found to have the Klebs-Loeffler bacillus in their throats. It will be seen on reference to Table XII, that the percentage of B diphtheria in the unhealthy throats, as a whole, was 32.3 in the Forest Gate Schools, and 35.7 in the other school; whereas the percentage of K. L. B. in the Class B was 47.3 per cent., and in the healthy school this percentage was 50.

TABLE XII.—*Showing comparison of Infected School with School where no Diphtheria had occurred for two years.*

—	Children.	A.	B.	C.	D.	Per cent. K. L. B. in Classes A, B, C.	Per cent. in Class D.	Per cent. of Total K. L. B. to School.	Per cent. of K. L. B. in Class B, to Total K. L. B.
Infected School	586	161	262	35	128	32.3 per cent.	32.8 per cent.	32.4 per cent.	47.3 per cent.
Healthy School	100	11	31	0	58	35.7 per cent.	6.8 per cent.	18 per cent.	50 per cent.

* *Münch Med. Woch.*, 1899, p. 1005.

† *Epidem. Soc. Trans.*, 1896.

‡ *Zeit. f. Hyg. und Infections-Krankheiter*, B. xxix, Heft. 2, 1898.

§ *Stat. Com. Met. Asylum's Board Report*, 1895.

This is the more interesting when we compare the percentage of diphtheria occurrence in the healthy throats of the two schools: we then find that at Forest Gate the percentage of children with healthy throats in which the diphtheria bacillus was found is 35.7 per cent.—that is to say, more than the percentage among the unhealthy throats; while at the other schools the percentage is only 6.8 for the healthy throats.

It will thus be seen that:

(*a*) The condition of the throats in the control school was much better than that of the throats in the infected school.

(*b*) That in the healthy school less of the healthy throats contained the diphtheria bacillus.

(*c*) That in both schools the largest number of the children in which diphtheria bacilli were found belonged to the Class B of enlarged tonsils.

One point further is worthy of note. In Table IX, I have collected the cases in which the diphtheria bacillus appeared in the children examined in the samplings, and who at the first examination were reported free.

It will be seen that of a total of fifty-one fresh cases, twenty-six of them were in Class B children.

Source of Infection.

During the epidemic the water and milk was examined bacteriologically, and the milk was found to contain virulent diphtheria bacilli. I was too busy at the time with the general bacteriological examination to examine both the milk and the water; the milk, collected by myself with the usual precautions, was handed over to Dr. Eyre, whose report I append. The water examination gave a negative result, the details of which are also appended.

It must be borne in mind that the epidemic was well under way when the milk was examined, the first cases of diphtheria having occurred some month and a half previously. There are many channels open for infection to the schools. The children are drafted from the Poplar Union, where during the latter part of 1898 diphtheria had occurred.

Visitors, the children's parents, and others, are constantly visiting the children and school; besides which, the children are allowed to wander outside the school on their own

account. It is thus difficult to make entirely certain of the origin of the primary infection.

The methods used in combating the epidemic were briefly as follows: (*a*) The children were isolated; and as the same dining-hall had to be used by both sections of children, the two classes were kept at the two ends of the hall. The knives, forks, and other domestic apparatus of the two classes were kept separate, and boiled after use. The infants were treated in the same way, but in the infant block, situated at some distance from the other part of the school. All indoor gatherings of the children were suspended for about three months; a large Aymard's milk sterilizer was put up, and all the milk coming into the schools was sterilized.

Up to the time that the milk was examined, the supply had been boiled in the kitchen coppers; but I found that the milk used by the officers was taken from the supply before the milk was boiled, and set on one side for use. This occurred to my knowledge with the sample examined, and found to contain virulent diphtheria bacilli, yet none of the officers contracted diphtheria.

The treatment of the children consisted of spraying the throats with a 2 per cent. solution of lysol. At first other solutions were used, but the lysol appeared to give the best results. There was no appreciable improvement in the percentage of children having the diphtheria bacillus in their throats, as will be seen from the percentages given in the Tables; but there is reason to think that the epidemic would have taken on a much more severe type if the above measures had not been adopted. That no improvement had occurred, as shown by the examination in September, should, I think, occasion no surprise. The condition of the throats had not been improved—in fact, could not be expected to improve, as far as enlarged tonsils and adenoids are concerned—by the simple spraying of the throat with an antiseptic: to say nothing of the fact that, as fast as a throat became free from bacillus, it was exposed to fresh infection from the other unhealthy throats. The throat spray was continued till the end of December, 1899, and then omitted; with the result that after some three weeks had elapsed, the number of sore throats has again commenced to rise.

Westbrook and Wilson,* Feer,† Aaser,‡ and many others,

* *Am. Suisses des Sciènces Med.*
† *Deutsche Med. Woch.*, May 30th, 1895.
‡ *Brit. Med. Journ.*, April 16th, 1898.

have shown that the continuance of an epidemic in isolated communities depends upon the bacilli carried in healthy throats; my own figures also show that the epidemic may cease, and yet the bacillus carriers be as numerous as ever.

Conclusions.

In briefly reviewing the epidemic, I venture to think that a bacteriological examination of the children, followed by rigid isolation, is a proper method to adopt in school epidemics. That milk sterilization should be always carried out with the whole of the supply, and no unsterilized portion retained for the use of any one in the institution. I further think that the method of sampling gives a sufficiently reliable result to determine the progress of the epidemic. That the unhealthy conditions of the faucial mucous membrane, especially hypertrophy, is a very large factor in the continuance of the diphtheria bacillus in the throat.

In conclusion, I must express my indebtedness to Dr. Downes, of the Local Government Board, for the facilitics obtained to examine a school free from diphtheria; and to Dr. Bell, the Medical Officer of the Poplar Schools, who has given me such valuable assistance.

Milk.

Re Specimen of milk received here February 5th, 1899, *at* 12.30 *p.m., per K. W. Goadby, Esq., L.D.S.*

A. The sample was examined quantitatively by means of "plate" preparations, to determine the number of organisms present per cubic centimetre.

The result of the count was that 10,960 organisms, at least, were present per cc. of the milk.

B. The sample was also examined qualitatively, with a view of determining the presence or absence of the bacillus diphtheriæ. For this purpose, cultivations were made upon inspissated blood-serum from

1. The cream.
2. The centrifugal deposit.

Thirty tubes in all were inoculated—fifteen from each source; and after twenty-four hours' incubation at 37.5 deg. C., the resulting growth in each tube was

examined microscopically by means of coverglass preparations, with the result that bacilli morphologically identical with the Klebs-Loeffler bacillus were found to be present in 50 per cent of the tubes.

One such bacillus was isolated, subcultivated on all the ordinary media, and its biological characters studied side by side with those of a typical B. Diphtheriæ; but no essential differences were detected.

The results of my cultivation experiments, therefore, led me to the conclusion that the organism I had isolated from the sample of milk was of a true diphtheria bacillus; and in order to confirm this supposition, a small guinea-pig was inoculated (in the subcutaneous tissue of the abdomen) with four milligrammes of a twenty-four-hours' old blood-serum culture. Sixty hours later the animal died, and at the post-mortem examination the lesions usually associated with death resulting from infection with the Klebs-Loeffler bacillus were found to be present, and the suspected organism was recovered from the seat of inoculation in pure culture. I therefore conclude that the organism obtained from the sample of milk submitted to me was a true bacillus diphtheria; and, moreover, one possessed of a fairly high virulence.

Signed J. W. EYRE, M.D., D.P.H.

WATER.

The supply consists of the East London Water Company's water delivered into a large tank, the tank supplying water to the kitchen sinks, and to the washing apparatus on the boys' side; in other places the supply is direct from the main.

Samples for analysis were therefore taken from the two sources:

(1) From the intake of the tank, *i.e.*, "The Main."
(2) From tap over kitchen sink, *i.e.*, "The Tank."

The samples were taken with the following precautions, by myself, on February 12th, 1899:

(1) Samples for determining the number of organisms present per cubic centimetre were taken in special glass-stoppered bottles, previously sterilized by heating, at a temperature of 160 deg. Cent., for three-quarters of an hour in the hot-air incubator. The bottles were placed in a

receptacle surrounded by melting ice immediately the sample was taken, and were kept in the apparatus until immediately before examination.

(2) Sample for determining the presence of Klebs-Loeffler bacillus and other organisms was taken in a Winchester quart glass-stoppered bottle, sterilized by heating to 160 deg. Cent., for three-quarters of an hour in a hot-air sterilizer, and taken immediately to the laboratory.

The samples for determining the percentage of organisms were treated as follows:

Quantities of 0.2cc to 0.5cc were added to melted gelatine, and plated. The colonies were enumerated on the third day. The gelatine used was nutrient broth (1 lb. lean beef per litre), to which 10 per cent. gelatine was added, and had a standard alkalinity of 3 per cent. normal NaOH per litre.

1 cc. of each sample was also treated by the method of Pakes for the detection of the coli group.

(2) The sample for determining the presence of the Klebs-Loeffler bacillus was treated in the following way:—

The whole amount taken was filtered through a Pasteur porcelain filtre under an exhaust pump.

The Pasteur filter was, in the first place, thoroughly cleaned by filtering through

(1) Saturated solution of potassium permanganate,

(2) Hydrochloric acid,

(3) Boiled water till the filtrate was no longer acid. The whole filter was then boiled for fifteen minutes before use.

After filtration of the sample, the residue was streaked on to a series of blood-serum tubes, which were then placed in the incubator at 37 deg. C. for twenty-four hours, at the end of which time the resulting growth was examined microscopically.

Details of Experiments.

(1) *Main.*—0.2 cc., 0.3 cc., 0.5 cc. were drawn off with a sterilized pipette, and added to the nutrient gelatine and plated. The colonies enumerated on the third day:—

0.2 cc.	...	9 colonies.	63 per cc.
0.3 cc.	...	21 „	
0.5 cc.	...	33 „	

1 cc. was also treated by the method of Pakes for detec-

tion of the Coli group, and subsequently plated on gelatine. No spreading colonies developed, and no organisms referable to the Coli group were found.

(2) "*Tank.*"—0.2 cc., 0.3. cc., 0.5 cc. were drawn off with a sterilized pipette, and added to melted gelatine and plated. The colonies were enumerated on the third day.

0.2 cc.	...	6 colonies	28 per cc. estimated.
0.3 cc.	...	10 „	
0.5 cc.	...	12 „	

1 cc. was also treated by the method of Pakes for the detection of the Coli group, and subsequently plated. No spreading colonies developed, and no organism referable to the Coli group were found.

Sample for Detection of Klebs-Loeffler Bacillus.

One Winchester quart was filtered by exhaust through a Pasteur filter, sterilized by method described above. The filtration occupied five-and-a-half hours. After filtration, the residue was streaked on to coagulated ox-blood serum tubes, and incubated at 37 deg. C. for twenty-four hours. Coverslip preparations were also made from the residue, no K. L. B. being found.

After incubation of twenty-four hours:—

Five tubes showed a few dotted colonies,

One tube remained sterile,

Three tubes showed large, watery, moist white colonies,

One tube showed whitish hard raised colonies.

On microscopical examination of coverslips made from the above tubes, and stained by carbolic methyline blue and by Neisser's stain, no Klebs-Loeffler bacilli were found.

From the above experiments I conclude that no Klebs Loeffler bacilli (diphtheria) were obtained from the samples examined, and that also no organisms of the Coli group, including B. typhi abdominalis were found; whilst the number of organisms present per cubic centimetre was extremely small. The difference between the numbers is a matter of no importance, as any number below 100 per cc. is decidedly good.

(Signed) Kenneth W. Goadby.

Bacteriological Laboratory, Guy's Hospital, S.E.,
February 22nd, 1899.

Report of Medical Officer.

Notes on the General Health and Presence of Infectious Disease at the Poplar Union Schools, previous to the Outbreak of Diphtheria of 1898-1899.

The general health and physique of the children during 1898 has been exceedingly good. Very little epidemic disease or general illness amongst the children, whose numbers are as a rule 600 to 650. During 1898 there had been, previous to November, two cases only: on July 29th, both boys. Of scarlet fever, in 1898, previous to November, there had been:—

March 7th	...	One girl.
April 4th to 28th	...	Ten girls and two infants.
May 6th to 24th	...	Four boys and one girl.
June 23rd	...	One boy.
August		

On December 23rd I sent a boy with apparently follicular tonsillitis, but in whose throat the disease seemed to be encroaching on the intermediate spaces between the follicles, to the Eastern Fever Hospital, for a diagnosis; and after two days, a diagnosis of diphtheria was made.

Under these circumstances, I therefore sent three other children, in various stages of tonsillitis, and in all the cases a diagnosis of diphtheria was given. It was then decided by my Committee to have a bacteriological examination of the whole school, which was undertaken by Mr. Goadby, and a large proportion of the children were found to have the B. Diphtheriæ in their throats. Some ten days after the result of the examination was made known, the isolation of the microbic from the amicrobic children was effected, and intercommunication entirely cut off between the two sets from that time.

In January, 1899, there were	13	cases of clinical diphtheria.				
„ February	„	„	5	„	„	„
„ March	„	„	31	„	„	„
„ April	„	„	9	„	„	„
„ May	„	„	5	„	„	„
„ June	„	„	1	„	„	„
„ July	„	„	1	„	„	„
„ August	„	„	0	„	„	„
„ September	„	„	1	„	„	„
„ October	„	„	0	„	„	„

From the time the children were isolated, the number of fresh cases decreased until April, when they again were mingled; there was a rise in the numbers at first, and then a rapid diminution, and we have not had a case for some eight weeks. All the cases save three were mild, and these three were children freshly imported into the schools from the seaside; in all these, symptoms of severe poisoning was most marked, with nasal and offensive discharge, anæmia and prostration.

The source of contagion could in no case be traced absolutely; but as there are some sixty people at work in the schools and living outside, and twice a week visitors are allowed to visit the children—whilst at times children are sent to the Union to visit their parents—there are several possible channels of infection.

On October 13th, 1898, there was an outbreak of a mild form of illness called Epidemic Influenza, the symptoms being: vomiting, headache, and a rise of temperature of 102 deg. F. to 105 deg. F., which lasted less than forty-eight hours; no sore throat, no rash, and no sequelae except a cough.

On November 27th, four infants were removed with scarlet fever.

Between December 1st and 31st, thirteen infants were removed with scarlet fever.

On November 22nd, 26th, and 28th, three girls were removed with diphtheria.

From December 10th and 30th, five boys and girls were removed with diphtheria.

Commencing on December 15th, an epidemic of high temperature began among the children.

The rise of temperature ranged from 100 deg. F. to 104.8 deg. F., and lasted from twenty-four to forty-eight hours; the throats appeared in most cases red, a little swollen and inflamed, and in about a third of the cases the follicle of the tonsils had a yellowish secretion; the whole of the children (upwards of fifty in number) made rapid recovery, twenty-four hours to three days appearing to set them in normal health again; there was no loss of colour, and no sequelae of any kind followed.

Between December 20th and 30th, four of the officers—two males and two females—were attacked in the same manner. Rigors, intense pain in head, back, and legs; temperature 104 deg. F., with a sore throat of a follicular nature. These all made a good recovery, and with the

exception of a cough that lasted about a fortnight, there were no sequelae. The tongue in all the cases was of a dirty yellow colour, and all complained of a disagreeable taste. These cases were called, in conjunction with those of the children, Epidemic Influenza, of which disease there had been a considerable amount in the surrounding district.

Of these three children, one admitted on February 11th was removed February 22nd.
Of these three children, one admitted on February 20th was removed February 25th.
Of these three children, one admitted on March 9th was removed March 17th.
Of seven children admitted to the schools, these three contracted the disease in a severe form.

Treatment of the cases of sore throat was—

A gargle mixture of ferri perchlor., potass chlor., and glycerine.
A spray of tr. benzoin co. and ol. eucalypt., carbolic and tr. iodi.

Altogether, 43 cases of clinical diphtheria were notified.

Prophylactic Measures.

Admission to the schools was practically stopped. Isolation of the known microbics from the amicrobics. Spraying of all the throats with a 2 per cent. solution of lysol until July, when a 1 per cent. solution formaline was substituted. Suspension of school, and as much fresh air as possible. Removal of cases of clinical diphtheria to the Fever Hospital as soon as diagnosis was made.

For the plan of isolation I am indebted to Dr. Goodall, of the Eastern Fever Hospital.

An Aymard's sterilizer was ordered, and its use began at the beginning of July. It is of 36 gallons capacity.

The total number of sore throats, not clinical diphtheria, from—

December 3rd, 1898, to January 28th, 1899, were			56
January 28th to March 6th	„	„	12
March 6th to April 2nd	„	„	9
April 2nd to June 21st	„	„	19
Total		...	96

This does not include children who complained of sore throat, but had no visible signs of any trouble.

The nature of the epidemic was mild. There were no fatal cases. There was no post-diphtheria symptoms shown by any of the children that were not removed to the fever hospital.

The general health of the schools is at present excellent.

G. CRAIGIE BELL, Medical Officer.

ADVANTAGES OF BACTERIOLOGICAL DIAGNOSIS AS INSTANCED BY THE HISTORY OF AN OUTBREAK OF DIPHTHERIA IN A LARGE SCHOOL.

By F. H. BERRY, M.D.Lond.

(*Read: January 19th*, 1900.)

The London Orphan Asylum at Watford is a large boarding-school, containing nearly 600 children, between the ages of eight and fifteen years.

The schools stand in their own grounds, in which there is a private chapel. Visitors are only allowed on certain days. Altogether, there is very little intercourse between the children and the outside world.

Both boys and girls are admitted: the boys numbering about 350, the girls something under 200. The school-rooms, living-rooms, dormitories and playgrounds for the two sexes are quite distinct, the children only seeing each other in the dining-room—a large room in which they occupy different sides, with a broad gangway in the middle separating them—and in chapel.

The food, including milk, is the same for both, and comes from the same source: an important fact, seeing that the diphtheria outbreak was confined to the girls altogether, and did not affect the boys.

I have now been connected with the School for sixteen years, and during that time there has been little or no diphtheria—clinical diphtheria, that is—till the 1898 outbreak. Indeed, I cannot remember a solitary case; but, as during a great part of the time, my late partner, Dr. Brett, was in chief charge and I only visited occasionally, I do not like to say positively there were none, but certainly there has been nothing like a serious outbreak. There are two holidays in the year—summer and Christmas—when the bulk of the children go home. After the return in January, 1898, we had several cases of sore throat among the girls—simple angina, to all appearance—some with a little

follicular lymph, some with a little temporary fever; but nothing that raised our suspicion as to its diphtheritic nature till February 25th, when a girl developed a typical membrane: so typical that we injected antitoxin, and sent her off to the isolation hospital, before we got the bacteriological report on the culture we had taken. This report confirmed our diagnosis, the K.-L. bacillus being found.

I may mention this was the only case we sent to the isolation hospital, the succeeding ones being treated at the infirmary at the School.

This solitary case of diphtheria was followed by a succession of apparently innocent sore throats. Then came a few days' lull; and then, on March 27th, another undoubted case of diphtheria (clinical and bacteriological diphtheria).

Between the 29th and 31st of March, we had three cases of slight sore throat, of all which we took cultures, and one them contained the K.-L. bacillus. We isolated these cases, of course.

Again we had the same story. A succession of slight sore throats—quite innocent, to all appearance—till April 30th, after which for a whole week no case was reported. This brought us to May 7th, on which day we had an undoubted case of diphtheria. This was followed by another on May 8th, and another on May 9th: and then on May 10th, we had three cases of suspicious sore throat, one of which proved to be true diphtheria. No boys were attacked. All the diphtheria cases bid fair to be severe, with high temperature, and much membrane and fœtor of breath. They were injected at once with antitoxin, and made rapid and satisfactory recoveries.

By this time we had had, for more than three months, a more or less constant succession of sore throats, with three outbreaks at intervals of about a month of undoubted diphtheria; each outbreak more severe than the previous one, and we felt that this succession must be stopped.

We had an empty house on the premises capable of holding fifty girls, and it was decided that we should examine *all* the girls' throats, isolate all those that were injected in this house, and ask Dr. Washbourn to come down and take cultures of them.

Until one has tried it, one has no idea how difficult it is to decide what *is* congestion of the tonsils, pillars of fauces, etc.; but we did our best, and out of the nearly 200 girls we put on one side, 76. All which girls, please remember, regarded themselves as well, and had made no complaint of sore-throat or other *malaise*. It was clear that 76 could

not go into a 50 house: so we went over them again, and divided them into "red-red" throats and "pale-red" throats; isolating the first lot, and sending the others back to school.

On the next day, Dr. Washbourn came down.

Report upon the Bacteriological Examination of the Throats of Children at the London Orphan Asylum, Watford. By J. W. WASHBOURN, M.D., F.R.C.P., Physician to the London Fever Hospital, Assistant Physician to Guy's Hospital, Demonstrator of Bacteriology, etc.

The examination of the throats was undertaken with the object of demonstrating the presence or absence of the diphtheria bacillus. With this object, cultivations were made on coagulated blood serum, and the resulting colonies were examined under the microscope by means of the usual cover glass preparations.

On the first occasion, namely, on May 14th, 1898, the tubes were inoculated directly from the throats by myself. On the subsequent occasions, namely, on May 16th, May 18th, May 20th, May 21st, May 23rd, May 27th, May 31st, June 1st, and June 7th, the inoculations were made, either by Dr. Berry or by Dr. Hardenberg, upon tubes which I had provided, and which were sent to the laboratory for examination. In all, one hundred and forty-two cultivations were examined. The result of the examination is here appended:—

I.

Tubes inoculated on May 14th, 1898.
Cultivation examined May 15th, 1898.

Nos. 1 to 81, A and B.

No growth— 11, 12, 13, 15, 18, 20, 36, 49, 53, 56, 57, 64, 65, 66, 68, 69, 77.
Ordinary throat organisms—1, 2, 3, 4, 5, 9, 14, 16, 17, 21, 25, 30, 31, 32, 33, 37, 39, 40, 43, 48, 50, 51, 52, 54, 58, 60, 61, 62, 63, 67, 70, 71, 72, 73, 74, 75, 76, 78, 80.
Few "Hoffmann"—6, 7, 22, 23, 24, 38.
"Hoffman" pure—8, 10, 19, 29, 34, 35, 47, 55, 79.
Diphtheria bacilli—26, 27, 28, 41, 42, 44, 45, 46, 59, 81, A, B.

II.

Tubes received May 16th, 1898.
Cultivations examined May 17th, 1898.

Nos. 90 to 93, 95 to 98.

Ordinary throat organisms—90, 91, 93, 97*a*, 97*b*, 98.
Few "Hoffman"—95.
"Hoffman" pure—96.
Diphtheria bacilli—92.

III.

Tubes received May 18th, 1898.
Cultivations examined May 19th, 1898.

Nos. 100 to 102. 0.

Ordinary throat organisms, 100.
Few "Hoffman"—101, 102.
"Hoffman" pure—0.

IV.

Tubes received May 20th, 1898.
Cultivations examined May 21st, 1898.

Nos. 103 to 105.

Ordinary throat organisms—105.
Few "Hoffman"—104.
"Hoffman" pure—103.

V.

Tubes received May 21st, 1898.
Cultivations examined May 22nd, 1898.

Nos. 106 and 107.

Ordinary throat organisms—107.
Few "Hoffman"—106.

VI.

Tubes received May 23rd, 1898.
Cultivations examined May 24th, 1898.

Nos. 108 to 112.

Ordinary throat organisms—108.
Few "Hoffman"—109, 111.
Diphtheria bacilli, 110, 112.

VII.

Tubes received May 27th, 1898.
Cultivation examined May 28th, 1898.

Nos. 113 to 116.

Ordinary throat organisms—113, 116.
Diphtheria bacilli—114, 115.

VIII.

Tubes received May 31st, 1898.
Cultivations examined June 1st, 1898.

Nos. 117 to 123.

Ordinary throat organisms—117, 118, 119, 121, 123.
Few "Hoffman"—120, 122.

IX.

Tubes received June 1st, 1898.
Cultivations examined June 2nd, 1898.

Nos. 1 to 22.

Ordinary throat organisms—1, 2, 4, 6, 8, 10, 12, 14, 16, 17, 20, 21, 22.
Few "Hoffman"—5, 7, 13, 18, 19.
"Hoffman" pure—9, 15.
Diphtheria bacilli—3, 11.

X.

Tubes received June 7th, 1898.
Cultivations examined June 8th, 1898.

Nos. 1 to 3.

Ordinary throat organisms—1, 2, 3.

J. W. WASHBOURN.

June 20th, 1898.

Taking section I of the Report, cases 1 to 38 were the red-red cases, cases 39 to 76 were the pale-red, and cases 77 to 81 were ill in bed with doubtful throats, temperature up. A and B were two cases that appeared healthy on inspection, but had complained of sore throat next day.

On looking at the figures, we find that three of the red-red and six of the pale-red contained the diphtheria bacillus. So here we had nine girls who thought themselves well, walking about with diphtheria in their mouths.

I would point out, too, the numbers of the girls affected—26, 27, 28, and again 41, 42, 44, 45; they were taken in their dormitory order. The succession certainly conveys the idea that the infection spread from child to child. We isolated all cases in which the bacillus had been found. For the next week or ten days, we took cultures of all girls who made any complaint of sore throat; these are sections II, III, IV and V of Dr. Washbourn's Report.

On May 22nd, one of the teachers (who live at the school) developed a sore throat, innocent enough to all appearance, of which I took a culture, and received a report that it contained the true K. L.; that is, Dr. Washbourn's 110 or 112. I then examined the throats of all the mistresses (about eight, I think), and found three of them red; two of these (114 and 115 of Dr. Washbourn's) proved to be diphtheria.

It is to be noted that two out of the three teachers that were infected were the music-mistresses; and that they teach in little glass-partitioned compartments, just big enough to hold a piano and two people. It is an excellent arrangement, I am told, to deaden the sound of other pianos in the same room; but one can easily see how it might conduce to the spread of contagion from pupil to teacher, and *vice versâ*. We allowed no gargle of any kind to be used before taking the cultures. Those in which antitoxin had been administered had no other treatment at all, neither spray, gargle, or paint: I mean local treatment, of course, I do not refer to internal medicine. Those cases which were not ill, but in which the bacillus had been found, were isolated for fourteen days and ordered to use an antiseptic gargle night and morning. They none of them developed any constitutional symptoms—or local ones either, for that matter—and at the end of the fourteen days we stopped the gargle for twenty-four hours, and then again took cultures and sent them up to town.

To return to Dr. Washbourn's report. Four of section VIII were cultures of the diphtheria cases that had been treated

with antitoxin; the others were fresh cases of simple sore throat. Section IX were the girls and mistresses that had contained the bacillus and were isolated in the unoccupied house before spoken of; only two—one mistress and one girl—were found still to be infectious.

Fresh cultures were again taken of these, and, together with one case of sore throat, sent up on June 7th (interval of a week). Section X of the report.—All were pronounced free, and after that we had no sore throat.

To sum up: we had no clinical diphtheria after the date of the inspection, and the succession of sore throats ceased after we caught the music-mistresses, or so soon after as to at least suggest the supposition that it was cause and effect. The thing undoubtedly was not perfect: for that we ought to have taken cultures of every girl's throat in the school. The objection to that, in an institution supported by charitable subscriptions, was of course the expense; but in a different class of school, where 5*s.* a head would make but little difference in the term's bills, I certainly think that it might and should be done, on any outbreak of diphtheria or even of much sore throat.

I do feel—and I think the facts bear me out—that by our action we stopped an outbreak that was steadily gaining ground, and that would in all probability have increased, both in the number and severity of the cases, had it not been checked at the time it was; and that we should have been powerless to do so but for the aid of the bacteriologist, as clinically there was absolutely nothing to distinguish the innocent from the infected throats.

I am a very indifferent bacteriologist, and, if any of my expressions are not very technical must ask you to forgive me. Dr. Washbourn thought the facts worth recording, and that must be my excuse for troubling you with this paper.

INSANITARY PROPERTY AND WORKMEN'S DWELLINGS IN LIVERPOOL.

By E. W. HOPE, M.D., D.Sc., Medical Officer of Health of Liverpool.

(*Read: February 16th*, 1900.)

ALL sanitary authorities, whether urban or rural, have obligations imposed upon them by the Legislature in regard to the sanitation of dwellings; and every ratepayer has the right, if he thinks fit, to seek the advice of the sanitary authority as to the sanitary condition of his house. But there is one section of almost every community, whose interests in this direction have long been handicapped by the fact that the places in which they dwell were erected prior to any legislation, and without regard to sanitary requirements. This section is commonly known as "the working class," by which is understood the varied wage-earning sections, from the skilled artizans to the large class of unskilled labourers, whose capacity is limited to work which can be discharged merely by strength of back; and it also includes the large and shifting class, of precarious occupation, of thriftless habit, helpless, indifferent, drunken, who have been described as the "submerged tenth."

The provision of appropriate habitations for this miscellaneous population is a work which is being faced in one way or another by almost every sanitary authority, urban or rural, not only in this country, but in Europe and America.

The problem is complicated by the fact that the tenements occupied by so many of these people are hopelessly insanitary, defective in construction, without adequate ventilation, without sanitary conveniences, and without yard spaces; these, massed together in congested areas, were built before buildings regulations were in force, or the necessity for them recognised.

The removal of these areas, and the re-housing under wholesome and appropriate conditions of the people occupying them, is the problem to be met; and in order to meet it properly, provision must also be made for streets of suitable width, for adequate open spaces, for playgrounds for

the children, for baths and wash-houses, and other accessories of this kind. Finally, these requirements must be so carried out that the houses shall let at rentals which the classes for whom they are intended can afford to pay.

When one carefully examines what is being done in centres of active sanitation, it becomes plain that the necessities of different towns vary, and that the remedy, and the means of applying it, must also vary. This applies not only to the structural peculiarities of the locality, but also to the character of its occupants. Effort to help those who are fairly steady and industrious will bear good fruit; but no more hopeless nor futile undertaking can be conceived of than the erection of cottages for the families of drunkards, unless they are to be regarded as almshouses or reformatories.

Liverpool affords one of the most striking illustrations of the benefits which have resulted from sanitary legislation, designed to improve the health of the poorer classes. To the city itself belongs the credit of initiating legislation in this direction, and establishing methods which slowly but surely are meeting the extreme and exceptional necessities of her case. I do not propose to refer to the great works carried out by the corporation in their endeavours to overtake the sanitary requirements of the city. The vastness and difficulties of the undertaking are not always realised; and the workers must not be discouraged by the attack of irresponsible critics, who never tire of referring the uninformed public to the apparent smallness of the results obtained.

Liverpool is a city in which many thousands of families are dependent upon the lowest class of unskilled labour. The enormous trade of the docks, and—at the present time—the work in reconstruction and extension in docks and warehouses, require the services of many thousands of labourers, and these must be accommodated either near to, or within easy and cheap access of, their work. Most of what is known as the insanitary property in Liverpool is situated in the older parts of the city, which run along the line of docks, and it is here that the great majority of the labourers have lived during the past three-quarters of a century.

This "insanitary property" is arranged in what is known as "courts," the general arrangement being well illustrated by the accompanying plans, from which it will be seen that the courts are back-to-back with one another. These courts admit of a structural classification, those erected

since 1842 being, by the Liverpool Building Act of that year, not less than 15 ft. wide throughout; but those erected prior to that date, and without any restrictions whatever, average about 8 ft. wide, and many of them are approached by narrow or tunnel passages about 2 ft. wide. The width, and the state of repair consequent upon age, are practically the only points of difference in the two kinds, but those erected prior to 1842 are by far the most numerous as well as the most insanitary. There are:—

Under Class I.

Courts.	Court Houses.	Front Houses adjoining Courts.	Total.
1,071	5,765	1,669	7,434

Under Class II.

Courts.	Court Houses.	Front Houses adjoining Courts.	Total.
83	606	144	750

Each court consists of eight to ten houses, which are back to back and side to side with others of similar structure; consequently, there is no yard space and no through ventilation. Each house consists of three rooms, placed one above the other, connected by a staircase, opening, so to speak, through a hole in the floor, so that the top cannot be reached without passing through the middle room. Water-closets, used in common by the occupants of the courts, are placed at one or other of the ends of the court, and at the opposite end is the receptacle for ashes. The closets are in full view of every house in the court: an arrangement not only subversive of decency, but leading to the retention of offensive matter in the houses in times of sickness or inclement weather.

The water is supplied from a standpipe in the courts. A great deal of the worst class of this property is very old, some of it appearing upon maps of close upon a century old. As might be expected, therefore, there are almost everywhere evidences of great dilapidation—perished mortar, decayed woodwork, disintegrated plaster, cracked and sunken flagging and stone-work. The property is far beyond the possibility of repair or reconstruction; indeed, from the cramped arrangement of the houses it would be hardly possible to erect one cottage with adequate yard space where three or four now stand, the overcrowding of houses upon the ground having been carried out with great ingenuity. The property is full of interest in connection with the records of disease and

mortality in the City; it is here that fever has perennially made its appearance, at times bursting out into serious epidemics; the ravages of cholera and of typhus fever have made some of these streets conspicuous in the annals of disease; and now, with every available sanitary adjunct brought to bear upon it—such as immediate removal of the sick to hospital, scavenging twice daily, unlimited water supply, prevention of overcrowding, and the constant supervision of the sanitary inspector—their annual rate of mortality from year's end to year's end ranges between 40 and 60 per thousand, in some years even exceeding this latter figure.

During the last fifteen years, 4,447 of these houses have been swept away at the instance of the corporation, and upon their sites dwellings—presently to be alluded to—have been erected, the guiding aim latterly having been the provision of dwellings for the *bonâ fide* labourer at a rental of 1*s.* per room.

When one considers the enormous supply of these three-roomed houses which existed in Liverpool, it is not surprising, in the absence of knowledge that they were insanitary, that no attempt was made to build other than cottages of four, five, or six rooms; and until the last few years it is a fact that no sanitary houses containing less than four rooms, or at a less rental than 5*s.* per week, could be obtained, with the rare exception of some few tenement blocks. Attempts, however, have from time to time been made to provide cheap sanitary dwellings, these attempts being invariably on the system of terrace houses or flats. The first houses of the kind were erected in 1863, in three-storied blocks, with separate houses consisting of three rooms, letting at an average of 1*s.* 3*d.* per room, approached on each floor by a common stair, and by continuous balconies facing the street. Although built in accordance with the bye-laws of those days, they are inadequate in many important particulars, more especially as regards open space at the rear. These were followed in 1867 by a four-story tenement block, consisting of four-roomed houses, let on an average of 1*s.* 6*d.* per room, in accordance with situation, being slightly more or less according to the floor. Within a few months, other blocks of somewhat similar kind were erected. In each case the owners are of opinion that the property has not paid them; and it will be apparent that the number of rooms in each tenement and the rental are not such as to meet the requirements of the poorest labouring population.

In 1868, the corporation erected six large blocks of dwellings, varying from three to five storeys in height. These contained four-, three-, and two-roomed tenements, the average rental being 1*s.* 5*d.* per room. Passing over other more or less unimportant attempts at providing dwellings for the labouring population, we come to an important series of buildings known as Victoria Square, erected by the corporation in 1883, upon designs of Mr. Dunscombe, on a site which had been cleared of insanitary property by compulsory demolition. The erection of this block was followed by the building, upon an adjacent site, of the Juvenal Buildings.

In 1896, Mr. Boulnois and Mr. Goldstraw prepared plans for labourers' dwellings, to let at a rental of 1*s.* per week per room. The erection of dwellings was proceeded with, upon types now to be described.

(Here details as to size of rooms, rental of each, etc., were supplied. Diagrams, drawings, and lantern slides illustrated the descriptions.)

With regard to the admistration of the dwellings owned by the corporation, it may be stated that the whole of their artisans' and labourers' dwellings are managed, and the rents collected by, a superintendent, at a salary of £120 per annum, with uniform, and having a residence and office at Victoria Square, with gas and coal (the latter for office use only), and a deputy-superintendent at a salary of £80 per annum, having a residence and office at St. Martin's Cottages, with gas and uniform.

The superintendent, while responsible for the letting and general management of the whole of the dwellings undertakes the collection of the rents and direct supervision of the Victoria Square and Juvenal Dwellings.

The deputy-superintendent is responsible for the collection of rents and the management of St. Martin's Cottages, Arley Street, and Gildart Gardens Dwellings.

The superintendent and deputy-superintendent are subject to the general authority of the corporation surveyor and his deputy, and the whole of the dwellings (except the St. Martin's Cottages, which under the jurisdiction of the Estate Committee) are controlled by the Dwellings Sub-Committee of the Insanitary Property and Artisans' Dwellings Committee of the City Council.

The salaries of the superintendent and deputy-superintendent are apportioned to the several dwellings, according to the amount of rental derived from each.

The rate of mortality in these buildings, taken as a whole, is about 21 or 22 per 1,000 per annum.

DESCRIPTIONS.

VICTORIA SQUARE.

(Opened December, 1885.)

These dwelling are comprised in five five-storey blocks, containing 271 tenements, 1 house for superintendent, with office, and 12 shops.

The rents of the tenements are as under, viz. :—

Ground, First and Second Floors.

					s.	d.	
4	Three-roomed	dwellings	...	...	at 5	6	per week.
59	,,	,,	...	...	5	3	,,
1	Two	,,	...	...	4	9	,,
5	,,	,,	...	...	4	6	,,
12	,,	,,	...	...	4	3	,,
59	,,	,,	...	...	4	0	,,
3	,,	,,	...	...	3	9	,,
3	,,	,,	...	...	3	6	,,

Third and Top Floors.

2	Three-roomed	dwellings	...	...	at 5	0	,,
21	,,	,,	...	...	4	9	,,
5	Two	,,	...	...	4	0	,,
2	,,	,,	...	...	3	9	,,
11	,,	,,	...	...	3	6	,,
61	,,	,,	...	...	3	3	,,
2	,,	,,	...	...	3	0	,,
21	One	,,	...	...	1	9	,,

Total weekly rental ... £54 4*s.* 6*d.*

Total number of rooms, 607.

The one-room tenements are 12 ft. by 12 ft. In the two-roomed tenements, the living-room is 13 ft. by 12 ft. 4 in., and the bedroom 15 ft. 3 in. by 9 ft. 7 in. In the three-roomed tenements, the living-room is 13 ft. by 12 ft. 4 in., one bedroom 15 ft. 3 in. by 9 ft. 7 in., and the other bedroom 13 ft. by 8 ft. 6 in.

The rooms in each tenement have a clear height of 9 ft.

On each landing, sinks have been provided, as well as a laundry, with boiler aud wash-places, for the use of the tenants of four dwellings in common, and there are also two water-closets, each common to two tenements.

	£
The estimated value of the land (*i.e.*, the price at which it was considered it could have been sold to builders), is 22*s.* 6*d.* per square yard, and the area being 9,000 square yards, the cost of the land is taken at	= 10,125
The total cost of the buildings	= 57,952
Estimated cost of land and buildings ...	= 68,077

The total gross rental of the dwellings for ten years (1889-1898) amounted to £29,990 6*s.* 5*d.*, of which there was actually received the sum of £28,315 5*s.* 7*d.*, equal to over 94 per cent. The empties during the period mentioned accounted for £831 4*s.* 3*d.*, while the irrecoverable arrears amounted to £702 4*s.* 10*d.*, the accumulated arrears from tenants still occupying being £152 14*s.* 9*d.*

Return of the Income and Expenditure for the Year ended 31st December, 1898.

Income—	£	s.	d.	£	s.	d.
Rents received as per Journal				3,050	8	9

NOTE.—In 1898-99 the corporation discontinued the supply of gas, automatic meters being fixed, and the rentals reduced by 3*d.* per week per tenement.

Expenditure—	£	s.	d.	£	s.	d.
Superintendent's salary (proportion)	52	14	8			
,, uniform (proportion)	1	12	6			
Official's guarantee	0	17	2			
Gas (including tenements, landings and staircases)	451	9	3			
Coal	1	1	2			
Rates and taxes	422	5	6			
Fire insurance	44	4	0			
Cleaning chimneys	25	15	0			
Stationery	7	6	6			
General disbursements ...	17	4	2			
Ironmongery and whitecoopery ...	17	18	10			
Plumbing, etc.	17	12	10			
Repairs, cleaning and whitewashing, etc.	352	18	11			
Tenants' compensation ...	0	5	0			
Lighting and attending lamps ...	32	3	0			
New storehouse	41	2	6			
Attendance of constable ...	2	18	8	1,496	9	8
Net income for the year =				1,553	19	1
= £2 5*s.* 9½ per cent.						

LABOURERS' DWELLINGS, JUVENAL STREET.

(Completed December, 1890.)

These dwellings are comprised in four blocks, three of which are four storeys in height, and one three storeys high, containing altogether 101 tenements and one shop, with which one of the dwellings is let.

The rents of the tenements are as under, viz.:—

Ground and First Floors.

						s.	d.	
2	Three-roomed	dwellings	...	...	at	5	6	per week
1	Two	,,	,,	...	...	5	3	,,
3	,,	,,	,,	...	...	5	0	,,
3	,,	,,	,,	...	...	4	9	,,
4	,,	,,	,,	...	...	4	3	,,
5	,,	,,	,,	...	...	4	0	,,
20	,,	,,	,,	...	...	3	9	,,
1	One	,,	,,	...	...	2	9	,,
1	,,	,,	,,	...	...	2	6	,,

Second and Third Floors.

2	Two-roomed	dwellings		...	...	at 5	0	per week
2	,,	,,	,,	...	...	4	9	,,
1	,,	,,	,,	...	...	4	3	,,
2	,,	,,	,,	...	...	4	0	,,
10	,,	,,	,,	...	...	3	6	,,
1	One	,,	,,	...	...	2	9	,,
3	,,	,,	,,	...	...	2	6	,,
38	,,	,,	,,	...	...	2	3	,,
1	,,	,,	,,	...	...	2	0	,,

Total number of rooms, 157.

Total weekly rental ... £16 7*s.* 3*d.*

The sizes of the rooms vary considerably, but generally they are as follow, viz.: One-room tenements, 14 ft. 3 in. by 11 ft.; two-room tenements, living-room, 14 ft. by 11 ft., and bedroom, 12 ft. by 11 ft.; three-roomed tenements, living room 14 ft. by 12 ft. 3 in., one bedroom, 14 ft. 3 in. by 14 ft., and another bedroom, 14 ft. by 9 ft. 9 in.

The rooms in each tenement have a clear height of from 9 ft. to 9 ft. 3 in.

The sinks are in the living rooms of these tenements, and w.c.'s (common to two or three families) are provided on each landing, the laundries (for use of tenants of each block in common) being on the roofs, the flat portions of which also afford drying accommodation.

	£
The estimated value of the land (if sold to builders) is 24*s.* per square yard, and the area being 2,538 square yards, the cost is taken at ...	= 3,045
The total cost of the buildings	= 13,121
Estimated cost of land and buildings... ...	= 16,166

The total gross rental of the dwellings for the eight years (1891-1898) amounted to £7,107 5*s.* 5*d.*, of which there was actually received a sum of £6,550 16*s.* 9*d.*, equal to over 92 per cent. The empties during the same period accounted for £193 18*s.* 9*d.*, while the irrecoverable arrears

amounted to £339 15*s.* 2*d.*, the accumulated arrears from tenants still occupying being £51 17*s.* 6*d.*

Return of the Income and Expenditure for the Year ended 31st December, 1898.

	£	*s.*	*d.*	£	*s.*	*d.*
Income—						
Rents received as per Journal				870	14	2
NOTE.—In 1898-99 the Corporation discontinued the supply of gas to the tenements (50) previously so provided, and reduced the rents 3d. per week per tenement.						
Expenditure—						
Superintendent's salary (proportion)	23	14	11			
Gas (including tenements, landings, and staircases)	100	6	0			
Rates and taxes	114	6	8			
Fire insurance	4	10	4			
Cleaning chimneys	8	15	0			
General disbursements... ...	7	14	4			
Repairs	61	19	10			
Lighting and repairing lamps ...	21	10	7	342	17	8
Net income for the year ...				...=£527	16	6
				=£3	5*s.*	3½*d.* per cent.

ARLEY STREET DWELLINGS.

(Opened June, 1897.)

These dwellings, which comprise thirty-four double tenements, are built in three blocks, each two storeys high. Each floor forms a separate flat, and each tenement has a separate entrance, direct from the street. The average sizes of the rooms are as follows :—

	ft.	in.		ft.	in.
Ground Floor.					
Living room	14	0	by	13	6
Bedroom	14	0	by	9	0
with bed recess	6	8	by	4	6
Scullery and Yard.	7	3	by	7	0
Upper Floor.					
Living room	14	0	by	10	0
One Bedroom	14	0	by	8	0
Another Bedroom	14	0	by	5	3
with bed recess	6	6	by	3	0
Scullery	7	3	by	7	0

Separate W.C.'s are provided, and the rooms in each tenement have a clear height of 8 ft. 6 ins.

The rentals are as under:

Ground Floor.

	s.	d.	
15 Two-roomed tenements	at 4	6	per week
2 ,, ,, ,, ...	4	0	,,

Upper Floor.

15 Three-roomed tenements	5	0	,,
2 Two ,, ,, ...	4	6	,,

Total number of rooms, 83.

Total rent per week ... £7 19*s.* 6*d.*

The estimated value of land (if sold to builders) is 12*s.* per square yard, and the area being 1,685 square yards, the cost is taken at	= £1,011	0	0
The cost of buildings	= 5,312	4	10
Total cost of land and buildings	= £6,323	4	10

The total gross rental (1897-98) amounted to £623, of which there was actually received a sum of £577, equal to over 92 per cent. The empties accounted for £11 9*s.* 6*d.*, while the irrecoverable arrears amounted to £13 5*s.* 0*d.*, the accumulated arrears from tenants still occupying being £21 5*s.* 6*d*

Return of the Income and Expenditure for the Year ended 31st December, 1898,

	£	s.	d.	£	s.	d.
Income—						
Rents received as per Journal				385	15	6
NOTE.—These rentals do not include supply of gas, which is provided by means of automatic meters.						
Expenditure—						
Superintendent's Salary (proportion)	8	19	11			
Repairs	24	9	8			
Cleaning	1	9	0			
Insurance Premium	2	16	3			
Rates and Taxes	62	15	4	100	10	2
Net Income for the year ...				£285	5	4
= £4 10*s.* 2¾*d.* per cent.						

GILDART'S GARDENS DWELLINGS.

From designs by Mr. Boulnois and Mr. Goldstraw.

(Opened April, 1897.)

(*Including Kearney Place and Purcell Place.*)

These dwellings are comprised in five blocks, each three storeys in height, the total number of tenements being 88.

Ground Floors.

		s.	d.	
1	Three-roomed tenement	at 4	6	per week
1	,, ,, ,, (Caretaker's house.)	1	0	,,
26	Two ,, ,, ...	3	6	,,

(Each of above tenements has separate yard, scullery, and w.c.)

First and Second Floors.

12	Two-roomed tenements	at 2	9	per week
40	,, ,, ,, ...	2	6	,,
8	,, ,, ,, ...	2	3	,,

(In each of these tenements a sink and separate w.c. have been provided.)

Total number of rooms, 178.

Total rental per week ... £12 7*s.* 6*d.*

The sizes of the rooms vary considerably, the houses built being of three types, but generally they are as follows:—

	ft.	in.		ft.	in.
Type "F"—Ground Floor.					
Living room	12	3	by	11	0
Bedroom	11	3	by	9	4
First and Second Floors.					
Living room	15	0	by	11	0
Bedroom	9	3	by	8	0
Type "G"—Ground Floor.					
Living room	15	0	by	10	0
One Bedroom	11	0	by	10	0
Another do.	11	0	by	10	0
First and Second Floors.					
Living room	11	0	by	10	6
Bedroom	11	0	by	10	0
Type "H"—Ground Floor.					
Living room	16	6	by	10	0
Bedroom	10	6	by	6	9
First Floor.					
Living room	13	9	by	8	0
Bedroom	16	9	by	6	6
Second Floor.					
Living room	16	6	by	11	0
Bedroom	12	0	by	9	9

The rooms in each tenement have a clear height of 8 ft., except those on the second floors, where the height is greater, being carried into the roof.

	£	s.	d.
The estimated value of land (if sold to builders) is 12*s.* per square yard, and there being 3,048 square yards, the cost is taken at	=1,828	16	0
The cost of buildings (including clearance of site)	=7,687	15	2
Total estimated cost of land and buildings...	=9,516	11	2

The total gross rental (1897-98) amounted to £692 7*s.* 3*d.*, of which there was actually received the sum of £616 13*s.* 0*d.*, equal to over 89 per cent. The empties for the same period accounted for £12 1*s.* 9*d.*, while the irrecoverable arrears amounted to £17 12*s.*, the accumulated arrears from tenants still occupying being £46 0*s.* 6*d.*

NOTE.—Several of these tenements were not occupied for a full year.

These dwellings are reserved, as far as practicable, for persons who have been dispossessed through the demolition of Court Houses.

Return of the Income and Expenditure for the Year ended 31st December, 1898.

	£	s.	d.	£	s.	d.
Income—						
Rents received as per Journal ...			...	524	10	3
NOTE.—These rents do not include supply of gas.						
Expenditure—						
Superintendent's salary (proportion)	11	19	11			
Rates and taxes	83	7	7			
Gas	13	18	0			
Repairs	25	17	6			
Cleaning	4	14	3			
Insurance	3	15	1			
Stationery	1	1	4	144	13	8
Net income for the year ...			...	379	16	7
			=£3 19*s.* 9¾*d.* per cent.			

The dwellings for the labouring classes now in course of construction in Dryden and Rachel Streets, are designed upon the following lines by Mr. Turton :—

The houses proposed are of two types, designated "A" and "B" respectively, each type comprising three blocks of houses three storeys in height, the inside dimensions of the rooms being as under, viz. :—

	ft.	in.		ft.	in.
Type "A"—Ground Floor.					
Living room	15	0	by	10	6
Bedroom	12	0	by	10	9
,, ...	12	0	by	9	6
,, ...	9	3	by	9	0
Type "A"—First and Second Floors.					
Living room	13	0	by	9	3
Bedroom	11	0	by	11	0
Type "B"—Ground Floor.					
Living room	15	0	by	10	9
Bedroom	11	6	by	10	0
Type "B"—First and Second Floors.					
Living room	11	0	by	11	0
Bedroom	10	0	by	8	6

All the houses are provided with separate water-closets, and, with few exceptions, separate sculleries. Provision has been made in every case for the storage of fuel; each house has also a food locker ventilated from the outer air, in addition to which the houses on the ground floor have yards for the exclusive use of their tenants.

Gas is intended to be laid on to each tenement, supplied by means of automatic meters.

The entrances to the houses on the first floor will be from a balcony, the stairs to which are at the end of each block, while the houses on the second floor will be approached by stairs from the same balcony.

In two of the blocks of type "A" the houses on the ground floor are interlocked, so as to provide three-roomed houses instead of four-roomed houses.

The total accommodation proposed to be provided is as under, viz.:—

5	Four-roomed houses
8	Three-roomed houses
119	Two-roomed houses
Total ... 132	(increased to 182.)

It is proposed to let the houses, approximately, on the following basis per week, viz.:—

	s.	d.	
Living room	1	6	per week.
Each bedroom	1	0	,,
Scullery and water-closet	0	6	,,
Yard	0	6	,,

The calculations as to cost are as follows:—

	£	s.	d.
4,788 square yards of land at 12s. ...	2,873	0	0
Estimated cost of buildings	12,227	0	0
Total estimate of land and buildings ...	15,100	0	0

The land has been valued at 12s. per yard, this being the standard figure which has been taken in all cases where houses of a similar description have been erected, and is a fair average price at which land has been sold by this committee for the erection of dwelling-houses.

	£	s.	d.	
The total estimated rental is ...	1,108	18	0	per annum.
Less 40 per cent. leakages ...	443	11	0	,,
Net estimated rental	665	7	0	,,

£665 7s. 0d. = £4 8s. per cent.

The amount deducted for outgoings, viz., 40 per cent., is based on the experience of five years' working of the Juvenal Dwellings, where the nett income has averaged 63½ per cent. of the gross rental, showing a deduction of 36½ per cent. for leakages, and a small margin has been allowed on this figure for any further outgoings that may arise.

There is, for the use of the occupants, a large recreation and reading-room.

It is proposed to lay hot water on to each dwelling, over the sink. This will result roughly in an increase of the rent of 6*d.* per week per house, representing 3*d.* for labour and fuel, and 3*d.* to repay capital. The provision of hot water, therefore, to the houses will mean an addition of about 1½*d.* per room.

The site is a good one, and an open space is provided opposite to the houses, and within five minutes' walk are the public baths and wash-houses in Burroughs Gardens.

Still more recently, some very excellent plans for dwellings to be erected in Kempston Street have been designed by Mr. Turton.

(The comparative advantages and disadvantages of erection of dwellings in suburbs were alluded to, the comparison being favourable to the erection of dwellings in the suburbs, which in Liverpool are easy of access.)

MEASLES: ITS DISTRIBUTION AND CONTROL.

(Being the Experience of an Epidemic of over 2,000 Cases.)

By T. ROBINSON, L.R.C.P.Lond., D.P.H.Camb., County Medical Officer Leicestershire.

(*Read: March 16th*, 1900.)

In the year 1898 there were in England and Wales 12,922 deaths, and a death-rate of 0.41 per 1000 living, from measles. These rates were the highest of all the principal zymotic diseases, except diarrhœa. Having been Medical Officer of Health for the Borough of Burton-on-Trent in that year, when the town was visited by an epidemic of measles of over 2,000 known cases, I propose to lay before you to-night, to the best of my ability, my experience of the distribution of the disease, and the methods of control.

The "estimated" population of Burton-on-Trent in 1898 was 51,664. This population is composed, in a very large proportion, of artisans and brewery employés. The houses occupied are chiefly four- and six-roomed, *i.e.*, having two or three bedrooms; are built of red brick, and, as a rule, in long rows sometimes extending contiguously down the whole side of the street, with no interval except the narrow archway entries.

The River Trent, Midland Railway, and the canal run through the town from north-east to south-west in an almost parallel direction, thus dividing the town into four parts; and on this conformation I shall have more to say later. The town lies on the gravel-bed of the Trent, except that portion on the south-east side of the river, which is on clay. The gravel-bed is about 18 ft. deep, and there is on an average some 4 ft. of subsoil water.

The compulsory notification of measles first came into force on December 1st, 1893, having been scheduled under

the Notification Act for three years. It has twice been re-adopted, the last occasion being last year (1899), on my advice.

TABLE A.

—	No. of Notifications.	No. of Deaths.	Death-Rate per 1,000 living.	
			Burton.	England and Wales.
Yearly average during Quinquennium 1884-88 ...	—	16	0.37	0.47
„ 1889-93 ...	—	18	0.39	0.39
„ 1894-98 ...	1360	32.4	0.64	0.42
Year 1894	1963	36	0.74	0.37
„ 1895	96	2	0.04	0.37
„ 1896	2453	86	1.71	*0.64
„ 1897	272	7	0.14	*0.43
„ 1898	2048	31	0.60	*0.41

* 67 other large towns.

This Table shows that there has been a biennial epidemic of measles during the last six years (1893 being a non-epidemic year), and that the number of deaths for the past fifteen years, and notifications for the past five years, were in yearly averages during the quinquennium 1884-88, sixteen deaths and a death-rate of 0.37; during the quinquennium 1889-93, eighteen deaths and a death-rate of 0.39; and during 1894-98, 1,360 notifications, 32.4 deaths, and a death-rate of 0.64. A large increase in the death-rate during the last five years has therefore taken place, solely on account of the increased case-fatality during one epidemic, viz., in 1896.

In the epidemic in 1898, on which my paper is founded, there were 2,048 cases and 31 deaths, giving a case-fatality of 1.5 per cent. and a death-rate of 0.60.

I am of opinion that fully 95 per cent. of all the cases were notified to, or otherwise came to the knowledge of, the sanitary authority.

The number attacked during following age-periods were:—

Under 1 year	 153	8 and under 9 years	... 81
1 and under 2 years	 221	9 „ 10 „	... 52
2 „ 3 „	 239	10 „ 11 „	... 40
3 „ 4 „	 316	11 „ 12 „	... 24
4 „ 5 „	 321	12 „ 15 „	... 27
5 „ 6 „	 286	15 „ 20 „	... 10
6 „ 7 „	 178	20 and over	 12
7 „ 8 „	 88		

The ratio of children under school age (who are throughout this paper called Babies) attacked to children attending the Infant Schools (called Infants) was, roughly, 80 to 100.

Distribution.

I shall endeavour to point out, as clearly as possible, how the distribution of the disease took place throughout the town, and in doing this I propose to follow the course of the epidemic. The map shows the division of the town into districts, as since suggested by me for the control of measles, and each district is dealt with separately.

District No. 3.—The epidemic started in No. 3 district. In the first nine houses infected—before February 6th—by eleven notified cases, the first case in each house was a baby; the other two cases (in one house) were school children, and being second cases, were not at the time of attack attending school. Of the nine first cases, three were clearly "imported," five occurred in an isolated block of buildings on the outskirts of the building area of the town in this district, one in District No. 8, one in No. 9, and one in the centre of this (No. 3) district. This last child, aged two, attended a tea meeting on January 27th, had the measles rash out on the 28th, and the case was notified on the 29th. This is the only case that I can trace likely to have carried infection to those at the meeting. Of the next eighteen cases notified from February 10th onwards—twelve days after this child aged two—twelve had been to this meeting: two were babies of mothers who had been to this meeting; two were second cases, one had visited an infected house, and one was "imported." It is interesting to note that two of the last cases were babies who had not been to this meeting, but whose mothers had. These babies were the first cases in the two houses, and were aged eight and eleven months respectively. After very careful and detailed inquiries, I came to the conclusion that the mothers must

have carried home the infection, the babies in arms being naturally the most likely to catch the infection.

It appears highly probable that this meeting was thus the chief cause of the epidemic getting a firm footing in the town.

Grammar School and Girls' High School (numbers on Map, 16 and 7).—The twelve children infected at this meeting included one boy and one girl—both notified on 12th February—who were scholars at the Grammar and Girls' High School respectively. Both these children were at school up to the day before the rash appeared, and as a result both schools were infected. In the Grammar School the disease spread chiefly at first amongst the boys in the same form as the previously mentioned case, but the attack at the girls' school was not so restricted. The first batch of cases were notified on February 22nd—eleven days after the last attendance at school of the first boy and girl.

Victoria Road School (number on Map, 4).—The first case was notified in Victoria Road School on February 12th. On February 24th, 25th, and 26th—twelve, thirteen, and fourteen days after the first case—four infants attending this school were notified as having measles; and on March 8th—ten, eleven, and twelve days after the four cases—the first real batch of notifications was received. Closure was at once recommended, and carried out two days afterwards, by which time there were in all forty-two houses infected. So soon as the disease had really got into the infant department on the 24th, 25th, and 26th February, it rapidly spread to the other schools, and, as is shown in the Table of this district—3—to the babies chiefly after the school had been closed for twelve days. (These Tables I shall explain fully under the question of Control.).

Grange Street School (number on Map, 5).—There were twenty-one first cases amongst the infant scholars of this school, and eight in previously infected houses before the school was closed; but, in spite of these rather large numbers, and although the school is situated between two other neglected schools, viz., Victoria Road and Wellington Street (number 6 on Map), there was never any direct evidence that this school was a source of infection, and the result of closure goes rather to prove this. The school really was closed on account of its situation.

Wellington Street School (number on Map, 6).—In connection with the infant department of this school, there were eighteen cases in newly-infected and three in previously infected houses before closure on March 30th; but

ten of the eighteen were notified as late as the 29th, leaving only eight cases notified previous to that date. The first case was notified on January 24th. As the ten cases notified would have been infected about March 14th, there were fully seven weeks between the first case and the school really becoming infected. During this interval of seven weeks several cases were notified in the neighbourhood of the school, but the disease did not spread to any extent until the infant department became a source of infection. Endeavours were made to restrict the epidemic to this—No. 3—district. From this school the disease was conveyed to six houses in No. 6 district, but did not at this time spread in this new district. Especial efforts were made, by frequent visits to the infected houses, etc., to obtain this result; and, I think, with some success, as it was not until three months later that the infants' department of the nearest school was infected, and then from another source.

District No. 4.—Special efforts were also directed to prevent the spreading of the epidemic from No. 3 to No. 4 district. There is only a fairly wide street dividing these two districts, and most of the children attend the schools in the districts they live in—but not all. To prevent the crossing over from No. 3 district to No. 4 when the schools in No. 3 were closed, all the children who so crossed over were excluded from school in No. 4 district, whether from infected houses or not. Unfortunately, this measure was not applied to the Sunday-schools, with the result I shall now point out.

Goodman Street School (number on Map, 3).—The first cases appeared amongst the Goodman Street infants between March 19th and 24th, and those were in children who had attended a particular Sunday school in this—No. 4—district. There were ten infant cases (eight of whom lived in this district, and two in No. 7), and three cases amongst babies who attended the Sunday school only. It is highly probable that this Sunday school was infected on March 6th; as there were two children, who lived and attended the day-school in No. 3 district, but attended this particular Sunday school in No. 4 district, notified on March 8th, and three more on March 9th. From the 6th to the 19th and 24th is thus thirteen to eighteen days between the notifications, giving a possible incubation period of nine to fifteen days.

It may, I think, be fairly concluded that the Sunday school was the medium of conveying the infection from No. 3 to No. 4 district. Single cases followed these, and

on the 4th, 5th, and 6th April several cases each day; in fact, the disease was just getting hold in the day school when the holidays fortunately commenced, on April 7th, by which time there had been thirty-nine infant cases. The epidemic never made real headway in this school, and consequently the number of babies attacked was not so great: the greatest number being in the first and second fortnight after closure.

District No. 2. *Horninglow Schools* (number on Map, 2).—The disease was introduced into this district from No. 4 through a Sunday school in the district, in exactly the same way as it was from No. 3 to No. 4. Between April 17th and 20th inclusive, eight children, who had all attended this Sunday school, were notified as having measles, and these were the first cases, and all resided in this new district. Three of these eight were infants, one boy, one girl, and three babies.

Infection was possibly conveyed to this Sunday school by an infant, aged four, living in No. 4 district, attending the day school in that district, but attending this Sunday school in No. 2 district, who was notified on April 7th, but who could only have been at Sunday school on the 3rd—a four-day interval between school and notification. The length of this interval rather precludes infection by this child, unless notification was somewhat late. The interval between the infection on April 3rd and the eight notifications on the 17th to 20th is, therefore, fourteen to seventeen days, giving an incubation period of ten to thirteen days. On April 25th and 26th, two more children attending this Sunday school were notified. In the following fortnight several second cases appeared, and a few first cases amongst babies. At the end of that time the day school was infected, the disease spread rapidly amongst the infants, and was subsequently conveyed to the babies in greater number. It appears, therefore, that this district was infected through a Sunday school: that from this Sunday school the disease spread slowly among infants and babies until the day school was clearly implicated, after which the spreading was rather more rapid. The Sunday school was early warned against admitting children from infected houses, and was closed on April 24th, nearly four weeks before the day school.

District No. 9.—The epidemic now broke out across the river, in No. 9 district. There had been a few cases amongst children attending schools—infected and non-infected—in other parts of the town, and three cases amongst babies;

but I had no knowledge, nor could I obtain any afterwards, of any case having attended the day or Sunday schools up to the time the school was infected.

Winshill School (number on Map, 18).—My first warning of the infection of Winshill School was sudden and severe, for on May 3rd I received no less than fourteen notifications, all from the infant department, and on the following three days there were nine, fifteen, and two notifications respectively. There was little chance of stemming the tide after such an outburst, especially under the conditions then so favourable to an epidemic. The explanation of the violence of the outbreak is, that the epidemics which visited Burton in 1894 and 1896 did not affect this district to any extent, and there was therefore a very large amount of highly susceptible material present. There can be no question as to the infants' department being infected, nor as to the rapid spread throughout the district in consequence.

District No. 8. *St. Peter's and Hill Street Schools* (numbers on map, 19 and 20).—The district was infected by isolated cases, which appear to have been introduced in several ways, viz., by imported cases, children attending schools in other parts af the town, etc., almost from the beginning of the year. The disease spread very slowly until St. Peter's Infant School became infected. When once introduced there it spread rapidly, first amongst the infants, and later to the babies in the district. The rapid spread here is accounted for in the same way as in the Winshill (District No. 9) instance, viz., that in the 1894 and 1896 epidemics the district had not been greatly affected. That the disease spreads chiefly through the medium of the infant school, and not to any extent until the schools are infected, is here exemplified. This is borne out by the following instance: In this district there are two infant schools. St. Peter's was the one infected, and the disease spread rapidly. In the other school—Short Street—two infants were affected, and three girls, and five babies in the neighbourhood of the school; but the infant department never became infected, and the disease only spread to the extent just mentioned.

District No. 5. *Broadway School* (number on Map, 13).—Again we cross over the river, to the south-west portion of the town. The neighbourhood of this school was first infected on March 25th, and a certain Sunday school was to a slight extent infected from this case in April. That introduction, together with one or two isolated cases otherwise introduced, and the "imported" case, sufficed to spread the disease slightly among the baby class. A few cases

also appeared in the day school, which could not be said to be a source of infection. In fact, it was not until the end of May—two months after the introduction of the disease into the district—that this day school was at all seriously affected. After that occurrence, there was a considerable and rapid increase in the cases in the infant and baby classes, but not to such a large extent as in some districts.

Uxbridge School (number on Map, 12).—Soon after the closure of the previously mentioned school, this one became infected; and the infant department being undoubtedly a source of infection, the disease spread rapidly. Scholars attend this school also from No. 6 district.

District No. 6. *Christ Church School* (number on Map, 11).—It will be remembered that this district was, early in the epidemic (in April), infected from No. 3 district. In addition to that, rather later on, there were several cases amongst scholars from another school in this district—Guild Street—which was not considered "an infective source" and therefore not closed. Here also at this time the babies were chiefly affected; and it was not until the disease was again introduced from No. 5 district, at the end of June and early in July—over three months after the first cases in the district—that the infant department of Christ Church school was attacked. After that the disease spread more rapidly, but not to a great extent.

There is still another school—Bond Street (number on Map, 15)—in this district. Here one infant was attacked, in a family recently removed from an infected part of the borough. The house was frequently visited and watched, with the result that there was no spreading of the disease, not even to houses in the same row.

District No. 7 (three schools, numbers on Map, 8, 8A, and 9).—The disease was introduced into five houses before April 7th (school holiday time), but did not take root in the infant department; and consequently, except for a few cases occasionally among the babies, there was no spreading of the epidemic.

District No. 1 (Shobnall, number on Map 1).—There was in this district only one baby attacked, and that clearly a case "imported" into the town. With proper precautions taken there were no further cases.

House-to-House Infection.—The following Table gives the house-to-house infection in babies and school children. Newly-infected houses only are taken. The numbers given in the first column are the number of newly-infected houses where there were cases next door; in the second column

where there were cases two doors off; and so on to three or four doors off. The total newly-infected houses notified is given in the last column. The Table shows also the percentages of the totals notified.

		Next Door.	2 Doors off.	3 Doors off.	4 Doors off.	Total Notified.
Babies	Number ...	83	36	17	19	316
	Percentage...	26	11½	5½	6	100
School Children	Number ...	114	89	53	58	878
	Percentage..	13	10	6	6½	100

It will be seen from this Table that the percentage attack on babies living next door to an infected house was 26 per cent. of all those who were first cases; that the attack on babies when there was a case next door was twice as great as when there was a case two doors off, and four times as great as when there was a case three or four doors off.

Amongst school children, the larger percentages when there were cases next door and two doors off would rather suggest some house-to-house infection, which it is almost impossible to avoid considering the early infectiousness of the disease.

It is almost impossible to compare the percentage attacks on the babies and school children together, as school infection must play a great part in the latter's case.

Conclusions Deduced.—(1) That measles first introduced into a district through the infant school—Sunday or day—at once spreads rapidly in that school and district; and that the degree of rapidity and extent of the spreading are inversely proportionate to the frequency of epidemics, unless early closure is carried out. (2) That the disease first introduced into a district by means of isolated cases does not spread to any extent until the infant school becomes infected. (3) That Sunday schools are an important factor in the distribution of the disease, not only in one district but from one district to another. (4) That the babies may be infected to a slight degree, and under certain circumstances before the infant school is infected; but that the greater proportion are infected, in a shorter time, *after* the schools. (5) That the danger of house-to-house infection is a serious one amongst the baby class, and

that in proportion to the proximity of the infected house, where houses are in close contact, so is the danger of infection. Solely brought about, I take it, through social intercourse.

CONTROL.

School Closure and its Results.—Having so far only dealt with the distribution of the disease up to the time of school closure, I propose to show the further distribution after that attempted remedy has been put into operation. To more clearly point this out, I have drawn up a series of Tables—one for each district—showing the incidence on the infants', girls' and boys' schools, and on the babies, *i.e.*, all the children in the district under school age. (The average age at which children start schooling is three-and-a-half years; they have to be passed up to the older schools before their seventh birthday—the average age for which is six-and-a-half years, but I have taken seven in my figures. The boys and girls leave school at about twelve years of age.) Column A gives the number of cases previous to closure; B, those notified within twelve days after closure—I have taken a rather short period of twelve days, in order to bring out more clearly how quickly the great majority of the infants are attacked and the great rapidity of spread; C, the cases in the period following the twelve days until the re-opening; D, those within three weeks after re-opening, and E the total cases; F is school attendance—firstly, the number on the school register, which may be fairly said to be the number living in the district; and secondly, the number in average attendance with which the notified cases may be compared—but in the last line is given the estimated number* of babies living in the district, and G gives the total cases notified in the district since compulsory notification came into force, and should be some guide as to the amount of susceptible material. The year previous, 1893, was a non-epidemic year. N. and P. in the various columns mean cases in newly and previously infected houses, and any second cases occurring in a house within eight days of the first case are put under the heading of N.

I will again follow the course of the epidemic, but leaving the Grammar and Girls' High School until the last.

* This number is calculated on the birth-rate of the population estimated on the number of inhabited houses, and may in some instances be rather high, but is useful as a guide.

District No. 3.—In examining Table 3, *Victoria Road School*, it will be seen that before closure there were 44 infants attacked out of 284 (15½ per cent.) in average attendance, within twelve days 39 (14 per cent.), and from then till re-opening only four (1½ per cent.). Altogether 87 infants out of 284 in average attendance (31 per cent.) were attacked, and out of 347 (26 per cent.) on the register. Considering the total cases in the six years, counting 1893 as a non-epidemic year, can it be fairly claimed that closure was beneficial so far as the scholars were concerned? I think not. Much benefit cannot apparently be claimed for the babies either; but, on the other hand, we cannot know how much further the disease might have spread had the schools not been closed.

Grange Street School.—At this school, as I previously remarked, the source of infection could not be traced to the infant department, and that this would appear to be borne out by the result of closure. Before that time 29 infants out of 192 (15 per cent.) in average attendance were affected; within twelve days, six (3 per cent.), and from then till re-opening four (2 per cent.); or a total of 40 out of 192 (21 per cent.) in average attendance, and out of 236 (17 per cent.) on the register. Good results were obtained in this case I think, as, judging by experience in other districts, had the infant department really become the source of infection, much larger percentages must have been attacked and therefore more babies—the class it is most desirable to protect.

Wellington Street School.—There is no boys' school here. Before closure, 26 per cent. of the infants in average attendance were attacked, within twelve days 16 per cent. more, and from then till reopening a further 5 per cent.; or a large total of 47 per cent. of those in average attendance, and 31 per cent. of those on the register. Much benefit therefore cannot be claimed in this instance.

The babies of this district were the first attacked, for in the first six houses affected the first case was a baby, and from them the spread seemed to be slowly amongst babies. Before Victoria Road School was closed, 24 babies out of an estimated 938 (2½ per cent.) were infected, within twelve days 30 (3 per cent.), and from then till reopening 96 (10 per cent.). The total percentage of babies attacked was 17½. It will be seen that, in spite of the babies being the first attacked, only an estimated 2½ per cent. of them were attacked before school closure, whilst in the second fort-

night after closure a much larger percentage became infected. The Table also shows that the spread of the epidemic amongst the babies ceased rapidly after it had died out amongst the infants; and with a percentage attack of 17½, can it be said that all the susceptible material was utilised?

I propose dealing with the incidence on all the boys' and girls' schools together later.

District No. 4 (see Table).—In this district there is only one day school. Before closure, 39 infants out of 221 (17½ per cent.) in average attendance were infected, within twelve days after only six (3 per cent.), and from then till reopening two (1 per cent.). The total infants attacked was 47 out of 221 (21 per cent.) in average attendance, and out of 288 (16 per cent.) on the register. Comparing these figures with the total cases in the last six years (1893 being a non-epidemic year), it may be fairly claimed that some good did result from school closure. Also, as only one infant was a first case in a newly-infected house during the second fortnight after school closure, it would appear that the disease did not spread to any extent amongst the school children whilst playing in the streets.

There were six babies out of an estimated 311 (2 per cent.) attacked before closure, within twelve days 19 (6 per cent.), and from then till reopening 19 (6 per cent.); or a total percentage attacked of 15. The attack on the babies after the infants, and the disappearance of the disease from amongst the babies as soon as it had ceased amongst the infants, are clearly shown on this Table.

District No. 2 (see Table).—In this district, it will be remembered, the epidemic was introduced by a fairly large number of cases from a Sunday school, and that it spread slowly amongst the infants and babies until the former's school was infected. Here 61 infants out of 170 (36 per cent.) in average attendance were infected before closure, within twelve days 10 (6 per cent.), and none afterwards. In all, 41 per cent. of the infants in average attendance were attacked, and nearly 34 per cent. of the total number in the register.

It is apparent that all the mischief was done before the school was closed; and the question arises whether the day school ought not to have been closed when the disease was first introduced into the district through the Sunday school. Possibly many infants and babies would have been protected.

Of the babies attacked, there were 23 out of an estimated 228 (9½ per cent.) before school closure, within twelve days 13 (6 per cent.), and then till reopening 22 (9½ per cent.); or a total of 27 per cent. The percentages of attack on both the infants and babies compare very unfavourably with those in No. 4 district.

District No. 9 (see Table).—This is the district in which there had been no epidemic at all for at least five years, and where the disease spread most rapidly. In the four days before closure, 46 of the 195 (23½ per cent.) infants in average attendance were attacked; within twelve days afterwards no less than 121 (62 per cent.), or a percentage attack in sixteen days from the first notification received, of 86. With such an extremely rapid attack, the epidemic must perforce soon wane, and thus we find that 21 more infants (11 per cent.) were attacked before reopening. The total percentage of infants in average attendance attacked was 96½; and of those on the register—and therefore living in the district—75.

This violent outburst affected the babies very severely; for, as the figures in columns A, B, C and D show, the numbers attacked were 3, 32, 96 and 8 respectively, or percentages of 1, 8½, 25½ and 2. The total percentage attack on babies was 37; this is by far the largest of any in the town, and is accounted for, no doubt, by the extensive incidence on the infants. It is clear in this case that the babies were infected after the infants' school, and that when the disease died out amongst the infants, then it ceased amongst the babies.

District No. 8 (see Table).—Only one infant school—St. Peter—was infected. Into this district—which was not greatly affected by measles during the previous five years—the disease was introduced for some time before the infant school was infected, but did not, in spite of the former freedom from the disease, spread to any extent until after that event. Therefore, similar results were obtained to those in district No. 9, as will be seen by comparing the two Tables. There were in all 90 per cent. of the infants in average attendance attacked, and 74 per cent. of those on the register, against 96½ and 75 in District No. 9.

The babies were attacked to a slightly less extent on the estimated number. The percentages were 2½ before the closure, 10½ within twelve days, and 15 from then till reopening; or a total percentage of 29. This smaller percentage attack rate on the babies is, no doubt, accounted for

by the fact that the other infant school in the district (Short Street) was not infected.

Districts Nos. 5 and 6 (see Tables).—In these two districts only three of the five infant schools were affected, and only with these, therefore, shall I deal. The Summer holidays commenced on July 7th, consequently, in columns D of the Broadway and Uxbridge schools, the period is three weeks of holiday, and not three weeks after re-opening school, as in the other Tables.

Broadway School.—It was not until two months after the first case notified in this district that the disease got into this school—the first infected in the district. At the time of closure, 30 infants out of 288 (10½ per cent.) in average attendance were attacked, within twelve days 17 (6 per cent.), and the total number was 51, being 18 per cent. of those in average attendance, and 14½ per cent. of those on the register. Noting the "total cases notified" in the six years, as before it will be seen that the district suffered heavily in 1894 and 1896, and that, therefore, there was not the amount of susceptible material present as in some of the other districts. On the other hand, the warmer weather—June or July—may have had some favourable influence on the attack rate, and school closure may have been a secondary factor in producing the smaller percentages. The three weeks of Summer holiday (column D) —a time very favourable to the intercourse of school children, playing together, etc.—did not produce any ill effects, as there were no cases notified in that period or afterwards.

Uxbridge School.—A careful examination of the Tables of Broadway and Uxbridge schools go rather to prove that school closure had some beneficial effect on the incidence amongst infants in the former school. The schools are in the same district, are not more than half a mile apart, and the children in the district practically attend either school. The number of infants attending each school is the same, and the number attacked before closure are identical. But in Uxbridge school the number of infants attacked "within twelve days" is twice as great as in Broadway school, and of those in column C the difference is even more marked.

Here, also, it will be noticed that the three weeks of holiday had no ill effects.

Christ Church School (number on Map, 11).—In this school the holidays commenced just as the school was

becoming infected, on July 8th, and column B and C therefore cover the period of closure, viz., four weeks' holiday. Up to the time of closure, 15 out of 198 infants in average attendance (7½ per cent.) were attacked, within twelve days 15 (7½ per cent.), and the total was 35, being 17 per cent. of those in average attendance and 13½ per cent. of those on the register.

In the three schools together, 21½ per cent. of the infants in average attendance were attacked, and 17 per cent. of those on the register, and therefore in the district.

The babies in the two districts (5 and 6) were early attacked, but in all before school closure only about 2 per cent. of the estimated number living. "Within twelve days" 34 (2½ per cent.) were notified, and during the next three weeks 66 (4½ per cent.), the total percentage of babies attacked being about 12. The spread of the disease to the babies does not appear, in this Table, to have abated so quickly as in other districts; this is explained by the varying dates at which the schools were attacked, the first school closing two weeks before the second and five weeks before the third.

District No. 7.—There are three schools in this district. I give this Table—with special dates in the columns A, B, C, D—to show how the disease may linger in a district amongst the babies, but not affect the district to any extent; and the reason for this, I would suggest, is that the infant school never became infected. Against this we must note that there was a very severe epidemic in this district in 1896, which no doubt protected many of the infants on this occasion; still, there must have been a number of babies over the 5½ per cent. attacked, who were susceptible had they been brought in contact with the disease.

Grammar School and Girls' High School (see Tables).—These two Tables show the sudden cessation of the epidemic amongst scholars after closure of schools, where the scholars can be properly isolated at home, even considering that these children have probably always been more carefully protected against infection in earlier life. A total of 32 per cent. of the infants were attacked, and 17 per cent. each of the boys and girls. I would point out that, after a period of twelve days after closure, there were no first cases amongst scholars attending these schools; therefore, by closing the schools for about three weeks, the infected families were weeded out and the schools reopened with safety.

Incidence on the Boys' and Girls' Schools.—The total number of children attacked during the year 1898, at seven years of age and under twelve, was 284. If we again refer to the "total cases notified" during the five years in each district, we shall see that, previous to being infected in 1898; the districts Nos. 2, 3, 4, 5, and 6—irrespective of whether the infant departments only or the whole schools were closed in 1898—were, by comparison, about as seriously infected in the 1894 and 1896 epidemics as in 1898, and that in all these districts the children attending the boys' and girls' schools almost entirely escaped. On the other hand, the districts Nos. 8 and 9, broadly speaking, escaped the epidemics of 1894 and 1896; therefore much of the susceptible material remained—hence the boys and girls were considerably affected. In the Girls' High School and the Grammar School, we find that the ages at attack are very much higher, by comparison, than those in the Board Schools; no doubt this is due to protection from attack in younger life.

Closure of Sunday Schools.—In all cases the Sunday schools concerned were notified of infected houses, or the Sunday school was closed as the day school was closed. In two instances, the Sunday schools, being sources of infection, were closed some weeks before the corresponding day school.

Conclusions on School Closure.—(*a*) That in every case, except Goodman Street and Grange Street schools, and perhaps districts Nos. 5 and 6, closure was undoubtedly carried out too late to be of much benefit to the infants; but to what extent might the disease have lingered in the infants' schools and amongst the babies had not the schools been closed? I would here incidentally remind you that it is not always the Medical Officer of Health's fault that there is delay in closing schools; (*b*) that good results can be obtained, not only amongst infants but babies also, when schools are closed at once, without waiting for the infant department to become a source of infection.

(*c*) That when an epidemic occurs every two years, the infant department need only be closed; but with longer intervals the more necessary will it become to close the boys' and girls' departments also.

(*d*) That the same department in all Sunday schools, in the neighbourhood of the closed day school, should be compulsorily closed as are closed in the day school. The sanitary authority ought to have this compulsory power

of closure or exclusion of scholars; for with that power the difficulty of closing some schools would be overcome, or the "keeping-open-for-just-another-Sunday" system would be abolished,—not to mention the safeguarding of the Medical Officer of Health from innumerable interviews with people who know a great deal more about Public Health than he does, and from accusations of favouring one religious sect to the disadvantage of another.

The area in which all the schools or certain departments are closed might be designated a "school infected district," and no children should be allowed to go out of that district to school in another district; or into that district when parts of a school are open from another non-infected district. (This dividing of the town into school districts for this purpose I suggested to the Burton authority—the conformation of the town, mentioned at the beginning of this paper, lending itself admirably to the idea.)

(*e*) That the power to temporarily—for one or two days—close a school on account of a threatened epidemic would be a most useful acquisition to the Medical Officer of Health, especially in dealing with measles. Two days' holiday would not dislocate the school work, if it were then found that to continue the closure was unnecessary; and it would give time, on the other hand, to get formal notices signed, etc., if the epidemic so developed as to warrant a continued closure.

Exclusion of Certain Scholars.—All scholars from infected houses were excluded from school for a period of twenty-eight days from the last notification. Of this the parents were notified as each case arose.

For similar reasons, all persons from an infected house should be asked to desist from attending public gatherings; and all ministers might assist by seeing that such persons did not attend the mothers' meetings, etc., either with or without the babies.

Information of the Presence of Measles.—Compulsory notification under the Notification Act is the chief source of information at Burton-on-Trent, and an excellent one too. But of all the usual methods of obtaining information, none is complete without the others.

Notification should be Compulsory.—My reasons for advocating this are (*a*) that there are many cases notified of babies who may be the cause of a serious spread of infection, which would not come to the knowledge of the sanitary authority except by compulsory notification;

these cases being both in houses where there are no school children, and also in houses whence other children actually attend school, but where the disease is unrecognised, either through ignorance, neglect, or purposely. (*b*) That the information thus obtained is more prompt, especially at week-ends and during holidays. Although I have no figures to support this, my experience is that most of the cases were notified within two days of the rash appearing. As a contrary experience, I can quote, however, the words of Dr. Spottiswoode Cameron, who says, concerning measles in Leeds* in 1895-6, where notification is not in force: "The illnesses in the recovery cases came to our knowledge an average of 15.1 days from the commencement of their attack. The average period before we heard of the fatal cases was 17.8 days. It will be remembered, of course, that a large amount of information as to recovery cases was obtained by visiting houses of absentees from school, and this information reached us only when the disease had already become prevalent." (*c*) That notification is of great assistance in determining as to the proper time for reopening schools. (*d*) That, as far as I have been able to ascertain, the case fatality appears to be, for some reason, smaller where compulsory notification is in force. I shall refer to this again, however. (*e*) That notification tends to impress the public with the necessity of care, and to teach them the dangers of the disease. (*f*) That the expense of notification cannot be much heavier than the very extensive and complex sanitary organisation substituted for it. That the expense is heavy I do not deny, and to reduce this I have advocated, and do advocate—with all fairness to the general practitioner—the notification of the first case every twenty-eight days in each household. For the past six years, the yearly cost to the Burton sanitary authority for notification has been equal to a $\frac{1}{8}$d. rate. (*g*) That the benefits of the Infectious Disease (Prevention) Act, when adopted, are not available for measles unless notification is in force. (*h*) That the legal definition of a dangerous infectious disease under the Public Health Act, 1875, more clearly includes measles after the adoption of the Notification Act. Because, the last Act passed to prevent infectious disease, viz., the Prevention Act, applies to only those diseases to which the Notification Act is applied; therefore, where measles is not notifiable, can it not be

* "Supplementary Report to the Urban Sanitary Authority of the Borough of Leeds, 1896."

argued that it is not considered so sufficiently an "infectious disease"—leaving out the word "dangerous"—as to be included in the latest measures for the prevention of infectious disease? The same remarks apply, of course, to whooping-cough, one of the most terrible of all infant complaints.

Notification by School Teachers.—Information thus obtained is no doubt valuable, but with properly enforced notification it is, and should be, quite a secondary source. Notification should be first made to the teachers by the sanitary authority, and all cases not so notified that are known to the teachers should be notified by such teachers to the sanitary authority. Where notification is not in force, I think the teachers should be paid for the information they are practically compelled to give, and the extra work.

Education of the People by the Sanitary Authority.—This measure is, to my mind, one of the most important. Handbills distributed from house to house, pointing out the signs, symptoms, and dangers of the disease, the precautionary measures to be carried out, together with the legal responsibilities and penalties—especially if enforced—will do much to limit the spread of measles. But, in order to give full effect to this measure, the plea of ignorance of the nature of the disease should not be a wholly defensible one; for, after a sanitary authority has distributed such information as suggested, parents should be required to show that proper diligence and care had been exercised by them.

On other preventive measures I do not propose to touch.

Case Fatality and Death-rate.

To the medical officers of health for those towns where notification is, or has been, in force, given in the Table on page 156, I am indebted for the information shown therein.

From this Table, which I regret does not contain all notifiable towns, it will be seen that, where notification is in force the average case fatality is from $2\frac{1}{2}$ to 5 per cent.; and that the highest case fatality was 7.3, at Reading in 1897—a non-epidemic year in that town.

Measles was withdrawn from the Notification Act at Sutton Coldfield, on the advice of Dr. Bostock Hill, M.O.H., who is of opinion that notification does no good. It is

interesting to note that, in this case, the average case fatality is the least of those on the list.

Very few towns without compulsory notification will, I think, be able to show, as an average, such low figures as these; at least, that is what I have gathered from the few records I have in my possession. If this is so, can it not be claimed that compulsory notification either brings to light more cases, or reduces the case fatality?

Also, such a divergence in the percentages of fatal cases in any one town will show that the number of deaths in any one year—and therefore the death-rate as well—can be but a poor guide to the prevalence of measles in that year.

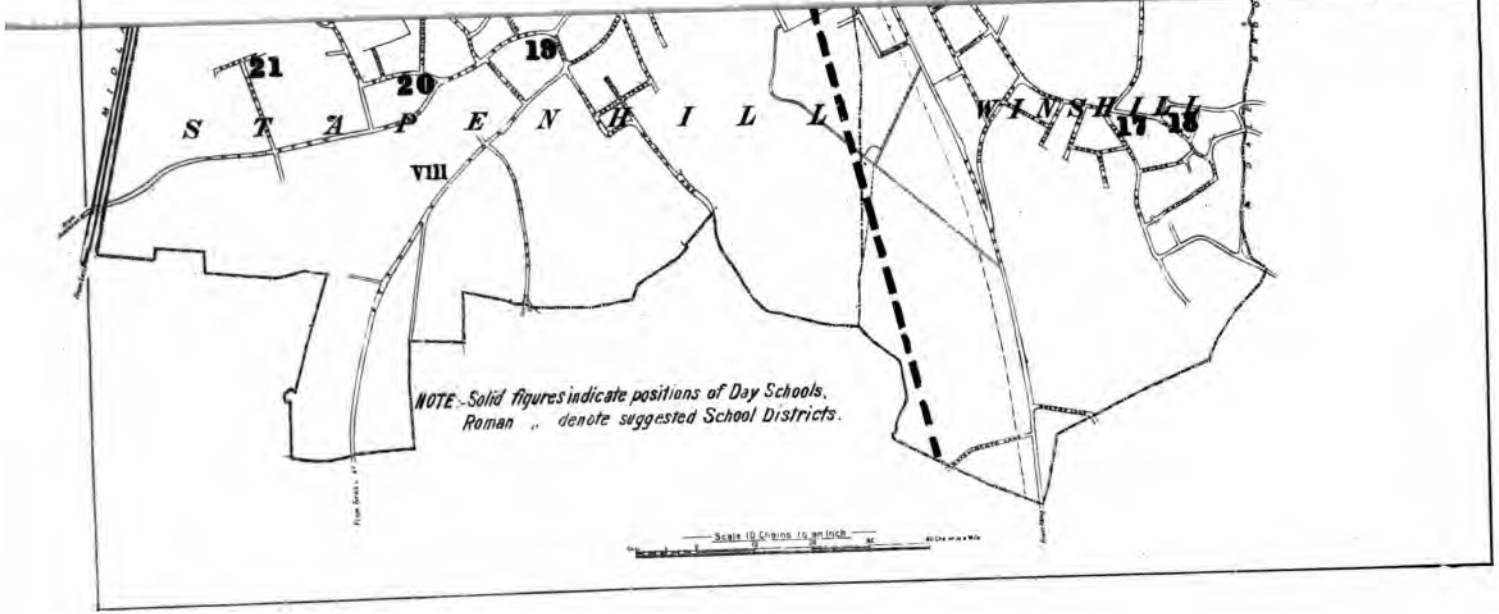
In conclusion, were measles called a "fever," I feel sure the public would think more seriously of the complaint.

Case Fatality.—Rate per Cent.

Year.	Local Act.		Notification Act.							
	Birkenhead(A)	Reading (C)	Kingston-upon-Hull.	Burton-on-Trent.	Coventry.	Withington.	Blackpool.	Kidderminster.	Penzance.	Sutton Coldfield.
1889 ...	5.77	2.0	—	—	—	2.5	1.1	1:7	—	0.0
1890 ...	5.49	1.0	—	—	—	1.9	4.6	7.1	5.9	4.7
1891 ...	6.49	4.2	—	—	2.7	2.9	4.0	2.6	2.5	0.0
1892 ...	4.09	3.4	—	—	1.2	2.0	0.0	2.3	0.0	2.4
1893 ...	2.78	6.8	6.1 (B)	—	0.0	0.0	3.3	4.5	0.0	1.7
1894 ...	5.17	1.5	3.0	1.8	2.3	1.6	1.9	1.7	0.0	0.0
1895 ...	1.16	3.8	1.6	2.1	2.6	1.2	2.8	3.2	0.0	1.7
1896 ...	5.22	2.6	4.0	3.5	2.9	0.8	2.7	—	0.0	0.0
1897 ...	4.73	7.3	2.9	2.6	—	1.8	2.9	—	2.8	1.3
1898 ...	5.09	2.4	2.8	1.5	—	4.7 (D)	2.7	—	0.0	—
Average	4.94	3.5	3.8	2.3	2.4	1.7	2.8	3.3	2.3	1.3 (E)

(A) Each Case notified.
(B) During time Act in force.
(C) All known Cases included in these figures.
(D) Act not in force.
(E) In the nine years, 1369 notifications and 18 deaths.

BOROUGH OF BURTON UPON TRENT.



District No. 3.—Victoria Road School.

First Case notified, Feb. 12th.	A Previous to Closure. To March 10th.	B Within 12 days. March 10th to 22nd.	C Then till re-opening. March 22nd to April 18th.	D Within 3 weeks. To May 9th.	E Total Cases.	F School Attendance. Number on Register.	F School Attendance. Number in Average Attendance	G Total Cases notified in District.
	N. P.	N. P.	N. P.	N. P.	N. P.			1894, 575
Infants ..	42 — 2	38 — 1	4 — 0	1 — 1	85—4	347	284	1895, 12
Girls ...	0 — 1	1 — 3	0 — 0	0 — 1	1—5	346	291	1896, 531
Boys ...	1 — 0	2 — 0	0 — 2	1 — 0	4—2	351	321	1897, 48
Babies* ...	17 — 7	12 — 18	38 — 58	7 — 7	74—90	938†	—	1898, 426

Whole School closed.

* Babies in whole District No. 3. † Estimated number living.

Grange Street School.

First Case notified, Feb. 10th	A To March 30th	B March 30th to April 11th.	C April 11th to 18th.	D To May 9th.	E Total Cases.	F. School Attendance. Number on Register.	F. School Attendance. Average Attend. ance.
	N. P.	N. P.	N. P.	N. P.	N. P.		
Infants...	21 — 8	5 — 1	4 — 0	0 — 1	30—10	236	192
Girls ...	2 — 2	0 — 0	0 — 0	0 — 2	2—4	267	237
Boys ...	7 — 0	1 — 0	0 — 0	0 — 0	8—0	365	330

Whole School closed.

Wellington Street School.

First Case notified, Jan. 24th	A To March 30th	B March 30th to April 11th.	C April 11th to 18th.	D To May 9th.	E Total Cases.	F School Attendance. Number on Register.	F School Attendance. Average Attendance.
	N. P.	N. P.	N. P.	N. P.	N. P.		
Infants...	18 — 3	13 — 0	3 — 1	0 — 0	34—4	120	81
Girls ...	0 — 0	1 — 0	0 — 1	0 — 0	1—1	112	100

Whole School closed.
School Holidays, April 7th to 17th.
Infant Department only kept closed until April 23rd.

District No. 4.—Goodman Street Schools.

First Case notified, Mar. 19th.	A Previous to Closure. To April 7th.	B Within 12 Days. April 7th to 18th.	C Then till re-opening. To April 30th.	D Within 3 weeks. To May 21st.	E Total Cases.	F School Attendance. Number on Register.	F School Attendance. Number in Average Attendance	G Total Cases notified in District.
	N. P.	N. P.	N. P.	N. P.	N. P.			1894, 186
Infants ...	39 — 0	6 — 0	1 — 1	0 — 0	46— 1	228	221	1895, 3
Girls ...	1 — 1	0 — 0	0 — 1	0 — 0	1— 2	291	249	1896, 173
Boys ...	1 — 0	0 — 1	0 — 0	0 — 0	1— 1	261	235	1897, 40
Babies ...	4 — 2	3 — 16	8 — 11	3 — 1	17—31	311*		1898, 133

Whole School closed from 7th to 17th April for holidays.
Infants' School only kept closed from 17th to 30th April.

* Estimated number living.

District No. 2.—Horninglow Schools.

First Case notified, April 17th.	A Previous to Closure. To May 19th.	B Within 12 Days. May 10th to 30th.	C Then till re-opening. To June 8th.	D Within 3 Weeks. To June 29th.	E Total Cases.	F School Attendance. Number on Register.	F School Attendance. Number in Average Attendance	G Total Cases notified in District.
	N. P.	N. P.	N. P.	N. P.	N. P.			1894, 101
Infants ...	56 — 5	10 — 0	0 — 0	0 — 0	66 — 5	214	170	1895, 4
Girls ...	2 — 0	0 — 0	0 — 1	0 — 0	2 — 1	200	174	1896, 130
Boys ...	3 — 1	1 — 0	0 — 0	0 — 0	4 — 1	213	190	1897, 26
Babies ...	13 — 10	6 — 7	10 — 12	1 — 0	30 — 32	228*		1898, 155

Infants' Department only closed.

* Estimated number living.

District No. 9.—Winshill Schools.

First Case notified, Mar. 18th.	A Previous to Closure. To May 7th.	B Within 12 Days. May 7th to 18th.	C Then till re-opening. May 18th to June 11th.	D Within 3 Weeks. To July 2nd.	E Total Cases.	F School Attendance. Number on Register.	F School Attendance. Number in Average Attendance	G Total Cases notified in District.
	N. P.	N. P.	N. P.	N. P.	N. P.			1894, 21
Infants ...	46 — 0	106 — 15	11 — 10	0 — 0	163 — 25	251	195	1895, 3
Girls ...	1 — 0	6 — 3	13 — 12	0 — 0	20 — 15	208	192	1896, 65
Boys ...	0 — 1	5 — 6	20 — 12	2 — 1	27 — 20	243	219	1897, 7
Babies ...	3 — 0	13 — 19	44 — 52	3 — 5	63 — 76	375*		1898, 450

Infants' Department only closed.

* Estimated number living.

District No. 8.—St. Peter's Street (Girls and Infants only), and Hill Street (Boys only).

First Case notified, March 8th.	A Previous to Closure. To May 19th.	B Within 12 Days. May 19th to 30th.	C Then till re-opening. To June 18th.	D Within 3 Weeks. To July 9th.	E Total Cases.	F School Attendance. Number on Register.	F School Attendance. Number in Average Attendance	G Total Cases notified in District.
	N. P.	N. P.	N. P.	N. P.	N. P.			1894, 65
Infants ...	45 — 2	75 — 11	2 — 1	0 — 0	123 — 15	186	154	1895, 38
Girls ...	1 — 1	5 — 4	1 — 5	0 — 0	7 — 10	167	150	1896, 158
Boys ...	3 — 1	4 — 5	8 — 4	0 — 1	15 — 11	378	346	1897, 10
Babies ...	2 — 9	23 — 22	21 — 42	3 — 2	49 — 75	424*		1898, 379

Short Street (Girls and Infants only).—Cases notified: Infants, 2 N.; Girls, 3 N.; Babies, 4 N.—1 P. School Attendance: On Register, Infants, 170; Girls, 198. Average Attendance, Infants, 141; Girls, 178.

* Estimated number living.

Districts Nos. 5 and 6.—Broadway School.

First Case March 26th	A Previous to Closure. To June 4th.	B Within 12 days. June 4th to 15th.	C Then till Holi-days. June 15th to July 7th.	D Within 3 weeks after. July 7th to 28th.	E Total Cases.	F School Attendance. Number on Register.	F School Attendance. Average Attendance	G Total Cases in District.
	N. P.	N. P.	N. P.	N. P.	N. P.			1894, 941
Infants ...	26 — 4	16 — 1	3 — 1	0 — 0	45—6	350	288	1895, 24
Girls ...	4 — 1	2 — 0	0 — 0	0 — 0	6—1	358	324	1896, 1110
Boys ..	2 — 1	0 — 0	0 — 0	0 — 0	2—1	400	367	1897, 137
Babies* ...	16 — 15	21 — 13	26 — 40	11 — 22	74—90	1431†	—	1898, 465

Holidays commenced July 7th. Infants only closed.

* August, N. 4 — P. 6.

† Estimated number living in whole districts.

Uxbridge School.

—	A	B	C	D	E	F School Attendance.	
First Case April 16th	To June 17th.	June 17th to 28th.	June 28th to July 7th.	July 7th to July 28th	Total Cases.	Number on Register.	Average Attend-ance.
	N. P.	N. P.	N. P.	N. P.	N. P.		
Infants...	26 — 4	30 — 5	6 — 5	0 — 1	62—15	350	279
Girls ...	2 — 2	4 — 1	0 — 0	0 — 0	6—3	362	320
Boys ...	0 — 0	1 — 0	1 — 0	0 — 0	2—0	394	373

Infants only closed. Holidays commenced July 7th.

Christ Church.

—	A	B	C	D	E	F School Attendance.	
First Case Mch. 26th	To July 8th*	July 8th to 19th.	July 19th to Aug. 5th.	Aug. 5th to Aug. 26th.	Total Cases.	Number on Register.	Average Attend-ance.
	N. P.	N. P.	N. P.	N. P.	N. P.		
Infants...	14 — 1	13 — 2	4 — 1	0 — 0	31—4	255	198
Girls ...	0 — 1	0 — 0	0 — 1	1 — 0	1—2	263	234
Boys ...	1 — 1	0 — 0	0 — 0	0 — 0	1—1	336	302

* Holidays commenced July 8th ; re-opened August 5th.

Girls' High School.

—	A Previous to Closure. To March 2nd.	B Within 12 Days. March 2nd to 13th.	C Then till re-opening. To Mar. 27th.	D Within 3 Weeks. To April 17th.	E Total Cases.	F School Attendance.
	N. P.	N. P.	N. P.	N. P.	N. P.	
Under 7 years...	3 — 0	2 — 1	0 — 1	0 — 0	5 — 2	22
Over 7 and under 12 years	10 — 0	8 — 3	0 — 0	0 — 0	18 — 3	160
Over 12 years...	6 — 0	0 — 1	0 — 0	0 — 0	6 — 1	

Whole School closed.

Grammar School.

—	A Previous to Closure. To March 2nd.	B Within 12 Days. March 2nd to 13th.	C Then till re-opening. To Mar. 27th.	D Within 3 Weeks. To April 17th.	E Total Cases.	F School Attendance.
	N. P.	N. P.	N. P.	N. P.	N. P.	
Over 7 and under 12 years	6 — 1	7 — 0	0 — 0	0 — 0	13 — 1	156
12 years and over	4 — 0	7 — 1	0 — 0	0 — 0	11 — 1	

Whole School closed.
None admitted under 7 years.

Three Schools.—District No. 7.

—	Previous to April 17th.	April 17th to May 10th.	June 11th to July 4th.	July 5th to July 30th.	Total Cases.	School Attendance.		Total Cases in District.
						Number on Register.	Average Attend-ance.	
	N. P.	N. P.	N. P.	N. P.	N. P.			1894, 80
Infants ...	1—3	2—0	0—0	1—0	4—3	261	204	1895, 11
Girls ...	0—1	0—0	0—0	0—0	0—1	295	252	1896, 219
Boys ...	2—0	0—0	0—0	0—0	2—0	292	248	1897, 4
Babies ...	1—1	4—2	2—2	2—2	9—7	283*	—	1898, 36

Schools not closed.

* Estimated number living.

INTRODUCTION TO A DISCUSSION ON THE INFECTIVITY OF ENTERIC FEVER.

By E. W. GOODALL, M.D.Lond.,
Medical Superintendent of the Eastern Hospital of the Metropolitan Asylums Board.

(*Read: April 20th*, 1900.)

The question which we have met together to discuss this evening is one which lies within very narrow limits. If we allow to the term "infectious" a wide interpretation: that is, if we include in that term all diseases which are propagated by the transmission of living micro-organisms from the sick to the healthy, there is not one of us who doubts for a moment that enteric fever is an infectious disorder. But when we pass on to consider the ways in which the *contagium vivum* of that disease may be conveyed, we find that there are at the present day signs of division in what has been for some time past practically an unanimous opinion. The doctrine with respect to enteric fever is that its infection is transmitted rarely directly, but almost always indirectly by the contamination of some article of food or drink with the specific alvine discharges. To avoid misconception, I will here state that by direct infection I mean the direct conveyance of the *contagium vivum* from the patient to a healthy person, through the medium of any of the secretions or excretions of the former. As examples of the prevailing doctrine, I will cite three well-known and widely-read text-books of medicine. Dr. Fagge,* after quoting certain examples of what were believed to be direct contagion, recorded by Dr. Budd and Sir William Jenner, refers to Dr. Collie's belief "that certain cases among the attendants at the Homerton Fever Hospital were caused by direct infection, either from the freshly-passed evacuations of patients or from their lungs or skin;" and then goes on to say: "but, striking as such occurrences naturally appear to the observer who watches their progress, there are strong grounds for rejecting this interpretation of them."

* Fagge, *Principles and Practice of Medicine*, 3rd Edition. Edited by Dr. Pye-Smith, vol. i, p. 160.

Dr. Taylor, in the last edition of his work on medicine, writes as follows: "It appears to be well established that nothing is given off from the body or breath of the patient to the surrounding air which conveys the disease to other individuals, so that doctors, nurses, and students in hospitals do not take enteric fever directly from patients;" while Dr. Dreschfeld,* in his article on enteric fever in Allbutt's *System of Medicine*," says that "the facts ascertained with regard to the outbreaks of typhoid fever are, briefly, that in very few cases is there any evidence of direct contagion from the sick to the healthy, etc." The late Mr. T. W Thompson, also, in a discussion of the methods of dissemination of enteric fever in Stevenson and Murphy's *Treatise on Hygiene and Public Health*,† states that "it becomes clear, therefore, that if enteric fever is infectious at all [he uses the term "infectious" in a very restricted sense], its infectiousness is, in ordinary circumstances, an insignificant factor in its dissemination." These extracts will serve to illustrate the prevailing opinion of the profession upon the question; but, as I have said, there are not wanting signs of a revolt against this opinion; and on this account, I suppose, the subject has been deemed worthy of being discussed by the Society on the present occasion. The questions raised are, firstly, is enteric fever infectious in the restricted sense of the term: that is, can its *contagium vivum* be transmitted directly from the sick to the healthy? And, if so, then secondly, to what extent does this mode of infection take place?

Now I need hardly remind the members of this Society that the belief in the direct transmission of the disease is by no means new. For some time after the period in which enteric had been clearly differentiated from typhus and other forms of continued fever, there were not a few men of great authority who held that belief. Amongst them were Bretonneau, Trousseau, Gendron, Piedvache, Budd, Sir Thomas Watson and—somewhat later—my predecessor at Homerton, Dr. Alexander Collie.

The evidence upon which these observers found their belief may be stated briefly as follows:—There were, firstly, the cases in which the disease was passed on from one person to another; as an example, I will quote an instance from Piedvache.‡ "In July, 1846, Mathurine Loyer contracted enteric. She occupied, with her family, the farm

* Allbutt's *System of Medicine*, vol. i, p. 804.
† Vol. i, p. 319.
‡ Abridged Translation, by Dr. Collie, 1879, p. 7.

of Quengo, commune of Brusvily. Her house, formerly a small country seat, is situated high, and is more spacious than the ordinary dwellings of peasants; but, as is the custom, the whole family slept in one room in several box-beds (*lits clos*). At the beginning of August, Jacques Loyer, aged 13, fell ill; on the 6th, Céleste, aged 26; on the 13th, Jean Marie, aged 25; on the 17th, Victoire, aged 19, who had slept with Mathurine; on the 19th, Widow Loyer; and on the 21st, Célestin, aged 16, who had slept with Jacques. A young girl, who had been engaged to look after the cattle, and who lived in the house, fell ill in September. She was removed to her family at Bodinais, and, as I shall show afterwards, propagated the disease there. The eldest son, who said that he had had "fever" during his military service, and a domestic, who slept in the stable and did not live in the house, escaped." Secondly, there were the instances in which a person suffering from enteric fever introduced the disease into a locality which had been previously exempt from it, and where the disease then spread to other persons. Budd's well-known cases may be quoted. I have not been able to refer to Budd's own version, but that given by Fagge will be sufficient. Three persons left the village of North Tawton, Devonshire, during the autumn of 1839, after having taken enteric fever. "Two of them went to Morchard and gave it, one to his two children, the other to a friend, and he again to his two children and to his brother. The third went to Chaffcombe, seven miles off, where ten others were attacked in turn, and two of these carried the disease to fresh places, with the result that several more cases occurred at each of them." Thirdly, there were the cases in which persons nursing enteric-fever patients caught the disease. Some of the instances placed under the first heading were doubtless of this nature. Dr. Collie* published an account of nineteen such cases. According to him, sixteen out of nineteen members of the staff of the Eastern (Homerton) Hospital, who contracted enteric fever in the course of their duties, were engaged in the enteric-fever wards; and of the remaining three, two were laundrymaids.

Time will not permit me to enter into details of the evidence brought forward years ago by those who believed in the infectivity of enteric fever; nor, for reasons I shall presently mention, do I consider it desirable that I

* *British Medical Journal*, 1879, vol. i, p. 384.

should do so. I wish merely to remind you that competent observers did hold very strongly that the disease was infectious. To what, then, are we to attribute the almost universal opinion to the contrary that prevails at the present day? I think that two factors have been working to bring about this result; the one is the great prominence that has been given to the undoubted connection that exists between defective drainage, the pollution of drinking water, etc., and the dissemination of the disease. The brilliant series of investigations that have been carried out by the staff of the Medical Department of the Privy Council, and, subsequently, of the Local Government Board, have, I venture to say, from their very brilliancy had the effect of diverting the attention away from other modes of propagation. The classical enquiries into the outbreaks at Wicken Bonant, Terling, Caterham, Caius College, Cambridge, Worthing and Maidstone, are examples of the researches to which I am alluding. But as an illustration how other modes of infection may be present unsuspected, it is only necessary to call to mind that it is but a very few years ago that attention was first seriously directed to the fact that the virus of enteric fever might be conveyed by contaminated shell-fish. On this point, however, I need not dwell; but I will pass on to consider the second of the two factors to which I believe we owe the doctrine concerning the communicability of enteric fever that is taught at the present day. This I believe to be the influence of certain writers, of whom, as far as this country is concerned, the late Dr. Murchison was certainly the most eminent. One cannot take up a text-book, whether of general medicine or of infectious diseases, in which, on the subject of the continued fevers Dr. Murchison's influence is not plainly evident. His figures and his facts, his conclusions and his opinions, are quoted over and over again. And justly so: for his "Treatise on the Continued Fevers of Great Britain" is a monument of industry and learning, and is based upon an experience which, at the time it was written, was almost unrivalled. It is desirable, therefore, that I should briefly set forth Dr. Murchison's views on the subject we are discussing, as they are given in the third edition of his work, edited by Dr. Cayley. He says:* "Although enteric fever is communicable, my experience is entirely opposed to the view that it is contagious in the strict sense of the term. Visiting, or

* Page 466.

contact with, the sick is neither sufficient nor necessary to produce it, and it is never propagated by a third person. As in dysentery and cholera, the alvine dejections appear to constitute the chief, if not the sole, medium of communication. This view . . . . . accounts for some of the differences of opinion on the contagiousness of enteric fever, as the disease would cease to be communicable when care is taken at once to remove and destroy the alvine evacuations. But, though enteric fever may be propagated by the stools of the sick, it does not follow that the sick give off from their bowels a specific virus like that of small-pox, as has been commonly argued. All evidence is in favour of the view that the fresh evacuations are harmless, and that the poison is developed during their putrefaction; in other words, that what has been demonstrated in cholera, both clinically and experimentally, holds good in the allied diseases, enteric fever and dysentery. The poison developed in the stools is either (*a*) propagated through the atmosphere; or (*b*) finds its way into the drinking water, and so enters the system by the digestive tract." Again:* "It may be communicated by the sick to persons in health; but even then the poison is not like that of small-pox, given off from the body in a virulent form, but is developed by the decomposition of the excreta after their discharge. Consequently, an outbreak of enteric fever implies poisoning by air, drinking water, or other injecta with decomposing excrement."

Now I might, if I pinned him down to a strict interpretation of his words, claim Dr. Murchison as an advocate of the infectiousness of enteric fever; for twice in the passages I have just read, he speaks of the conveyance of the poison from the decomposing stools through the air; for if that is not direct infection, I do not understand what is meant by the term. It is true that Dr. Murchison (and on this point his editor, Dr. Cayley, follows him) attached great importance to the decomposition of the enteric stools as a necessity for their infectiousness. But I must confess that none of the evidence brought forward on this part of the subject, either by him or by Dr. Cayley in his Croonian Lectures in 1880, appears to me to be at all convincing; indeed, it seems to me to be a splitting of hairs to talk about the decomposition of enteric stools. As Dr. Collie has observed in one of his papers, many enteric stools (I should say, all) are already decomposing when they are passed; and I

* Page 499.

cannot help thinking that Dr Murchison's pet theory of the independent, pythogenic origin of the disease unconsciously biassed his mind when he was considering this and kindred problems. But whatever interpretation is put upon the passages I have read from Dr. Murchison's work, it is quite clear, when we turn to the chapter where he discusses the evidence advanced by those who advocated the infectious nature of enteric fever, what he really thought. He did not believe in it, except to a very limited extent indeed; and this opinion of his has dominated the mind of the profession up to the present day.

When I was considering the class of evidence put forward by the early believers in the infectiousness of enteric fever, I stated that I did not consider it desirable that I should enter into details. At this length of time it is impossible to exclude in each individual instance other modes of infection. It would be no more justifiable for me to assert, on the evidence as it has been handed down to us, that direct infection was present in every case, than I consider it was justifiable for those who argued on the other side to assume that such cases as I quoted above from Piedvache not only might be, but necessarily were, capable of other explanations.* Consequently, I shall not bring forward any old evidence, but shall turn to that which, though of a similar character, is of recent date.

To take firstly the cases in which there is reason to believe that the disease is passed on from person to person. It is clear, from a perusal of the reports of Medical Officers of Health in different parts of London and the country, that the opinion is gaining ground amongst them that this mode of propagation of the disease is more common than is usually believed. I do not profess to have made anything approaching an exhaustive enquiry into the details of the subject—indeed, time has not sufficed me to do so; but I shall put before you some typical instances, for the reports concerning which I am indebted to the gentlemen who have recorded them.

Dr. Priestley, Medical Officer of Health for Lambeth, in a report dated December, 1899, relates the following cases. He prefaces his account by the following remarks.

"There has been recently in Lambeth an increase in the number of cases of typhoid fever, *i.e.*, over the autumnal average; and in my investigations I have succeeded in tracing the source and spread of three local epidemics, the histories of which are interesting from an

* *Vide* Murchison, *loc. cit.*, p. 459.

etiological point of view. Typhoid fever is generally regarded as a water-, or milk-, or (recently) shellfish-borne disease, its spread by actual contact from person to person being considered somewhat rare, so that the subjoined details are noteworthy as showing that in all probability typhoid spreads by actual contact oftener than is generally supposed—difficulties in the latter case in collecting the facts and showing their inter-relationship being considerable. The contagium is the typhoid bacilli of Eberth, which pass from the patients in large quantities through the bowels and the kidneys, and so may infect other persons, directly by contact, or indirectly through food, thereby rendering extreme cleanliness of person amongst those attending upon the sick of the greatest importance. The details are as follows :—

"Group I.—Louisa J. (age 37 years), living at 7, M—— Place, off the Wandsworth Road, was ill with obscure symptoms which were eventually shown to be those of typhoid fever; and the case was, after the disease had run a few weeks of its course, notified, and the usual precautions then taken. It was too late, however, as the disease had already directly spread :—

"(1) To a daughter, Ada J., 10 years of age, living at the same house ;

"(2) To a friend's two children, Frank and Edith S., aged 4½ years and 11 years, living at 8, M—— Place (this house being opposite to No. 7, in the same narrow and confined court) ; whilst Frank S., at 8, M—— Place, gave the disease to his brother Fred (17 years of age), with whom he slept ;

"(3) To a friend, Ada M., aged 30, living at 5, M—— Place, two doors removed from No. 7, and, of course, in the same narrow court.

"By means of a house-to-house enquiry, no more cases were found in the court, and all the patients were removed to hospital, and the houses and their contents thoroughly disinfected, and the walls of the infected rooms, in each case, stripped. The roadway of the court was found to be in an unsatisfactory state, and has been attended to by the surveyor ; whilst the houses (14 in number) have been thoroughly inspected, and since registered by the Vestry under Houses Let in Lodgings. No further case has since occurred in this district—a satisfactory result, as there were at the time several centres of infection in a crowded court, consisting of 14 houses, containing 56 rooms, with 23 families, numbering in all 132 persons, 59 being children under 10 years of age—the conditions of the persons themselves, and their crowded and dirty surroundings, being such as to form a suitable nidus for the rapid growth of typhoid germs.

"The exact source of the first case (Louisa J.), of Group I could not be traced.

"Group II.—Joseph H. (aged 22 years), living at 42, B—— Street, sickened with obscure symptoms (which afterwards proved to be due to typhoid fever), with the result that the case was not at first notified, and the usual precautions were, therefore, not taken, in the way of isolation, etc., until three or four weeks of the illness had gone, during which time the patient was a source of infection to others, as shown by the disease spreading directly :—

"(1) To a lodger, Thos. M. (age 29 years), living in the same house;

"(2) To a sister, Annie H. (age 15 years), living at 4, R—— Place, a street close by;

"(3) To a friend, John T. (age 20 years), living at 49, B—— Street;

"(4) To a friend, William T. (age 30 years), living at 67, B—— Street, and he has since given the disease to his daughter, Clara T. (age 9 years);

"(5) To two other persons living in the same street, Ernest J. (aged 10 years), of 32, B—— Street; and Harriet F. (age 30 years), of 71, B—— Street: but a relationship between these cases and the others could not be definitely traced, though it was rendered highly probable by the histories as to dates of sickening, etc.

"Some of the above cases were discovered as the result of a house-to-house enquiry, and all the patients were removed to hospital, and the houses and their contents thoroughly disinfected, and the walls of the infected rooms, in each case, stripped. No further case has since occurred in this district.

"M—— place is a court opposite to R—— Place, which is a short street leading to B—— Street, but no intercommunication could be proved between the cases of Group I and those of Group II, except perhaps in the local public-house, which was (so it is reported) frequented in common, as also a general-dealing shop at the corner of M—— Place.

"The exact source of the first case (Joseph H.) of Group II could not be traced.

"Group III.—John L. (age 26 years), living at a house in Lower Kennington Lane, sickened with obscure symptoms about August 12th, and eventually died without the medical man in attendance recognising the disease as typhoid fever, although in all probability it was so, as shown by subsequent events. During his illness, and after death, his clothes, bedding, etc., were removed from time to time to be washed, to 59, W—— Street, his mother-in-law's house, and directly infected:—

"(1) His mother-in-law, Matilda J. (aged 47 years), living at 59, W—— Street;

"(2) A brother-in-law, Harry J. (age 15 years), living at 59, W—— Street;

"(3) A sister-in-law, Sophia J. (age 24 years), living at 59, W—— Street; and Sophia J. gave the disease to a friend's child, Frank P. (age 4 years), living next door (61, W—— Street).

"(4) His wife, Matilda L. (age 26 years), who, after her husband's death, went from the house in Lower Kennington Lane to live with her mother at 59, W—— Street.

"(5) Alfred L. (age 14 years), living at 4, W—— Street, a fellow schoolmate of Harry J. (see No. 2, above).

"The usual precautions were taken as to isolation, disinfection, etc., and the infected rooms, in each case, were stripped. No further case has occurred in this district, which is too far removed to have any connection with the districts mentioned in Groups I and II.

"The first case (John L.) of Group III appears to have become infected at New Shoreham, where he had been spending his holiday; the disease manifesting itself three days after his return to Lambeth.

"Careful enquiries failed to connect any of the cases of Groups I, II, and III with infected water or milk, or even with oysters (or other shellfish); and by a process of exclusion I am driven to regard, therefore, the cause of the outbreaks as contact from person to person—(1) directly, or (2) indirectly, through infected clothes, food, etc."

The next group of cases is recorded by Dr. Fraser Bryett, Medical Officer of Health for Shoreditch, in his annual report for 1898.

"As illustrating the danger of enteric fever spreading amongst the members of a family when there is a lack of proper precautions, the following series of cases is of interest:—

"Case 1. B. P., male, aged 19, living at No. 64, B—— Street, had been poorly for a few days prior to August 1st. On that date he spent the day in the country with Mr. and Mrs. S. and their family, who resided at No. 136, B—— Street, and they all had meals together. On August 16th, B. P. died, and his illness was certified to have been enteric fever.

"Case 2. Mrs. S., aged 44, was taken ill about August 10th, and was thought to be suffering from influenza. She was ill for six weeks, being confined to bed, and at times delirious. Her recollection is very indistinct as to the period of her illness. Although not certified as such, there is very little doubt that this was a case of enteric fever.

"Case 3. Mr. S., aged 40, husband of above, occupied the same bed at night for a considerable period of her illness. He was taken ill about September 1st, and was confined to his bed for three weeks. This case also was not certified as one of enteric fever.

"Case 4. E. S., aged 19, daughter, who nursed her parents during their illness, was taken ill about September 12th, certified as suffering from enteric fever on October 1st, and died on October 2nd.

"Case 5. G. S., aged 20, son, was taken ill about the same date as E. S., was certified as suffering from enteric fever on October 4th, and died on October 18th.

"Case 6. W. S., aged 14, who had been in the habit of sitting with with his brother G. S. during his illness, was taken ill about October 4th. He was certified as suffering from enteric fever on the 21st, and removed to hospital. He died on November 9th.

"The house No. 136, B—— Street was in fair sanitary condition, and nothing of importance was discovered which could be directly connected with the causation of these cases.

"The histories of the cases point to the probability of case No. 1 infecting case No. 2, and case No. 2 passing the disease on to case No. 3. Cases 2 and 3 not being recognised as of an infectious

character, the chances of other members of the household being infected were materially increased. Cases Nos. 4 and 5 appear to have received infections about the same date, and case No. 6 was most probably infected through case 5.

"So far as could be ascertained, none of the cases of enteric fever in Shoreditch during 1898 were attributable to milk infection, nor could any cases be traced to the consumption of infected oysters or ice cream."

Lastly, I will refer to the groups of cases recorded by Dr. Boobbyer, Medical Officer of Health for Nottingham, in a paper read before this Society on February 17th, 1899. I will read the account of one group, especially as it is also an example of the disease being introduced from one place to another, where it has spread.

"George M., a coal-miner, aged 36, working at Wollaton, and living at 75, Kennington Road, Old Radford, was attacked with the disease about September 26th. He was apparently affected at Wollaton, as two other men working with him at Wollaton Pit, but living outside the town, were infected about the same time. This man was laid up at Kennington Road on September 29th. Prior to his attack, there had been no case of typhoid in the neighbourhood since the early part of May. George M. died of the disease on October 4th. Between September 26th and December 11th, eight other members of his household, his brother and brother's child, living in the same street, and occasionally visiting his house, a midwife and her daughter, also living near, who both assisted in nursing and looking after the sick household, were attacked with the disease. Later still, two other neighbours who had visited the patients became infected. The people in Kennington Road and its vicinity were repeatedly warned of the danger of infection, and how best to avoid it. Very little food appeared to be taken by the neighbours in the affected houses, and the special pails provided for the dejecta of the latter were carefully shunned; but, speaking generally, it is of course too much to expect that people of this class will be punctiliously clean and careful in their habits."

It will be observed that these cases differ from those recorded by Dr. Priestly and Dr. Bryett, with respect to the system employed in the removal of the excreta. In the one, the pail, in the other the water-closet system was used. In the Lambeth outbreaks, removal of the sick to hospital and disinfection of the premises arrested the spread of the disease. With further details of a similar nature I will not weary you. Dr. Boobbyer states, in the paper I have quoted from, that he has made up his mind long ago that the risk of infection to persons having at all intimate touch of typhoid patients is greatly in excess of that usually taught by the medical profession. Dr. A. Hill, Medical Officer of Health for Birmingham, in his report for 1898, says, that in his opinion "there were at least eighty-six cases of typhoid fever, or one-seventh of the total number, directly

due to infection from another case;" and in his fourth quarterly report for 1899, he speaks of personal infection as being "one of the greatest factors in the spread of the disease;" while Dr. John Robertson,* Medical Officer of Health for Sheffield, writes as follows: "My own experience in the investigation of the cause of nearly two thousand cases of sickness from typhoid fever goes to show that, roughly, about 10 per cent. of all the cases were probably due to direct infection, such as occurs when a nurse becomes infected from her patient." Dr. Reginald Dudfield, of Paddington, and Dr. Gwynn, of Hampstead, may be cited as holding somewhat similar opinions; and I doubt not but that a more extended enquiry would reveal a like belief in others.

Another argument in favour of the infectivity of enteric fever is to be found in the frequency with which those in attendance upon the sick catch the disease. Instances of this kind have already been given respecting patients nursed at home. With respect to those nursed in hospital, I will bring forward the experience of the hospitals of the Metropolitan Asylums Board of recent years. I have drawn up the six following Tables, which show the number of cases of enteric fever, scarlet fever, and diphtheria occurring amongst the staff of all the Fever Hospitals and Ambulance Stations of the Board during the eight years 1892 to 1899. The Tables also give the number of admissions of enteric fever cases for all the hospitals separately during the same period, but only the yearly total admissions of scarlet fever and diphtheria cases. To the information contained in the note to Table I, I may add that all the hospitals have during these years admitted large numbers of scarlet fever cases, and that a large number of scarlet fever and diphtheria patients are transferred to the Northern and the Gore Farm Hospitals.

Turning to Tables I and II one remarkable fact is apparent, namely, that at the four hospitals (N.E., F., N., and G. F.) where practically no enteric cases have been under treatment, there have been but two cases of that disease among the staff. It will, doubtless, be pointed out that in the remaining hospitals the number of staff attacked varies very much. But I would remind you that there is very great variation in the administrative details in the individual hospitals; I mean, in such matters as proportion of staff to patients, size of wards, number of beds in each ward, changes in the staff, and so on. And it

* *Brit. Med. Journ.*, vol. ii, 1898, p. 423.

must further be recollected that if in any particular hospital nurses who had previously suffered from enteric fever were specially selected to nurse the cases of that disease, that hospital would not afford any evidence of direct infection. I am also prepared to admit that some of the members of the staff contracted the disease outside the hospital, just as might happen with any other disease.

It is an interesting fact that, comparing the number of cases of illness amongst the staff with the number of cases of the different diseases treated in the Asylum Board's hospitals, the incidence is highest in the case of enteric fever. Thus, for every hundred cases of enteric fever admitted, 1.6 persons on the staff contract the disease; while for scarlet fever and diphtheria the figures are 0.6 and 1.3 respectively. I do not lay any stress on these figures, as the question of the ages of the members of the staff is here one of immense importance.

TABLE I.—*Cases of Enteric Fever occurring amongst the Staff in the M. A. B. Hospitals.*

Year.	E.	N.E.	N.W.	W.	S.W	F.	S.E.	P.	B.	G.	N.	G.F.	Total.
1892	5	0	1	3	4	...	0	...	...	...	0	0	13
1893	8	0	1	2	0	0	1	...	...	...	0	0	12
1894	1	1	0	1	4	0	0	...	...	...	0	0	7
1895	4	0	0	1	4	0	2	...	...	...	0	0	11
1896	2	0	2	1	0	0	4	...	1	...	0	0	10
1897	2	0	1	0	2	0	2	0	0	...	0	0	7
1898	0	0	0	1	2	0	2	1	0	...	0	0	6
1899	7	1	5	3	2	0	1	2	10	3	0	0	34
Total	29	2	10	12	18	0	12	3	11	3	0	0	100

NOTE.—The Fountain Hospital (F.) was opened on October 30th, 1893, for scarlet-fever cases only. Since October 2nd, 1894, cases of diphtheria have also been admitted. The Brook Hospital (B) was opened on August 31st, 1896. The Park Hospital (P.) was opened on November 8th, 1897. No enteric cases were admitted that year. The Grove Hospital was opened in the autumn of 1899.

The North-Eastern and the Fountain Hospital have never admitted enteric cases except by accident; nor have the Northern and Gore Farm Hospitals, except a few convalescent cases sent to the former in 1892.

The North-Eastern Hospital has never admitted diphtheria cases, except by accident.

TABLE II.—*Enteric Fever Admissions, M. A. B. Hospitals.*

Year.	E.	N.E.	N.W.	W.	S.W	F.	S.E.	P.	B.	G.	N.	G.F.	Total.
1892	157	...	82	38	91	..	138	...	...	...	(37*)	...	506
1893	178	3	123	54	125	...	61	...	...	...	...	...	544
1894	152	1	114	63	128	...	76	...	...	...	...	...	534
1895	97	2	122	78	129	...	233	...	...	...	...	...	661
1896	116	...	106	82	97	...	162	...	37	...	...	...	600
1897	105	1	149	64	94	...	174	..	77	...	...	...	664
1898	156	3	207	88	79	...	183	60	93	...	...	...	869
1899	243	7	300	194	109	...	233	100	108	241	...	...	1535
Total	1204	17	1203	661	852	...	1260	160	315	241	(37)	...	5913

* These 37 cases were convalescent patients transferred from other hospitals, and are not reckoned in the total.

TABLE III.—*Cases of Scarlet Fever occurring amongst the Staff in the M. A. B. Hospitals.*

Year.	E.	N.E.	N.W.	W.	S.W	F.	S.E.	P.	B.	G.	N.	G.F.	Total.
1892	10	9	6	16	12	...	8	...	...	...	6	3	70
1893	8	25	7	8	4	6	15	...	...	...	4	4	81
1894	7	16	2	7	8	6	12	...	...	...	8	4	70
1895	5	9	2	3	3	9	9	...	...	...	3	...	43
1896	6	6	6	10	3	7	10	...	16	...	13	7	84
1897	7	5	8	4	5	13	11	5	31	...	10	24	123
1898	3	3	10	10	9	5	8	15	17	...	7	13	100
1899	8	3	8	15	6	11	8	10	12	1	6	8	96
Total	54	76	49	73	50	57	81	30	76	1	57	63	667

TABLE IV.—*Total Scarlet Fever Admissions into the M. A. B. Hospitals.*

1892	...	13,093	1897	...	15,113
1893	...	14,548	1898	...	12,125
1894	...	11,598	1899	...	13,290
1895	...	11,271			
1896	...	15,982	Total	...	107,020

TABLE V.—*Cases of Diphtheria occurring amongst the Staff in the M. A. B. Hospitals.*

Year.	E.	N.E.	N.W.	W.	S.W	F.	S.E.	P.	B.	G.	N.	G.F.	Total.
1892	10	...	10	6	12	...	3	...	...	...	...	3	44
1893	8	...	1	2	...	...	1	...	...	...	...	...	12
1894	5	1	9	3	6	...	12	...	...	...	...	5	41
1895	10	2	12	5	6	10	6	...	...	...	11	...	62
1896	5	2	5	6	2	13	12	...	6	...	10	20	81
1897	7	3	5	6	5	14	10	...	6	...	9	16	81
1898	14	3	7	8	1	15	10	14	17	...	5	6	100
1899	17	1	3	5	5	16	6	21	19	4	5	11	113
Total	76	12	52	41	37	68	60	35	48	4	40	61	534

TABLE VI.—*Total Diphtheria Admissions into M. A. B. Hospitals.*

1892	...	2,009	1897	...	5,673
1893	...	2,848	1898	...	6,566
1894	...	3,666	1899	...	8,673
1895	...	3,635			
1896	...	4,508	Total	...	37,578

It would be very instructive to institute an enquiry into the circumstances of the cases of enteric fever amongst the staff at each hospital separately. But I am able to give the facts for the eight years in the case of the Eastern Hospital only. The twenty-nine cases are made up as follows: assistant medical officer, 1; charge nurses, 5; assistant nurses, 11; ward maids, 7; ambulance nurse, 1; laundry maid, 1; members of the adjoining ambulance station, 3. Of these, the medical officer, 3 charge nurses, 9 assistant nurses, and 5 ward maids were employed in the enteric wards when they contracted the disease, while some of the rest may also have been similarly engaged; for I have included amongst the negative cases two or three in which the record of their illness gives no information on this point.

Up to the end of 1893, the removal of the soiled linen from the enteric wards was effected in the following manner. The nurse—usually an assistant nurse, often

aided by the ward maid—took the linen from the bed, and placed it in a zinc-lined wicker basket which stood outside the door of the ward. Subsequently, it was counted over by the assistant nurse in the presence of the laundry-superintendent, and it was then removed to the laundry by the laundry-porter. But in consequence of the incidence of enteric fever upon the staff of the enteric fever wards, a tank was made, which was placed in the court outside the wards, and which contained an antiseptic solution. The linen was at once removed from the ward and thrown straight into the tank, from which it was subsequently removed by the laundry porter. The same man has been engaged in this occupation for the whole of the eight years. In addition to the introduction of the tank, I also instructed the matron of that time to have the enteric fever wards nursed as far as possible by members of the staff who had had the disease. These precautions seemed to have had some effect, for during the succeeding five years only six members of the staff were attacked, for two of the 1895 and one of the 1896 cases came from the adjoining ambulance station; of these six, four were certainly working in the enteric wards. I must further add that, up to the summer of 1894, there were four twelve-bedded wards set aside for enteric fever. At that time the number was reduced to two, and this arrangement obtained till October 1898, when the use of the two twelve-bedded wards for this purpose was discontinued, and two twenty-bed wards were employed instead, and have been so used up to the present time. The tank system is still in use. Yet, during 1899, seven members of the staff contracted enteric fever; four of them were assistant nurses employed in these wards; one was a wardmaid similarly employed; and since the end of last year another assistant nurse has contracted the disease in an enteric ward. Of the remaining two persons, one was an assistant nurse constantly employed on ambulance duty, and the other was an assistant nurse who, at the time, was working in another part of the hospital.

I believe that the chief reason of this renewal of enteric fever amongst the staff is, that during the end of 1898 and the beginning of 1899, there were many changes amongst them, in consequence of an arrangement introduced by the matron, by which the proportion of assistant to charge-nurses was largely increased. There was, therefore, a considerable addition of young women of an age particularly susceptible to enteric fever.

There is no reason to suppose that the experience of the fever hospitals of the Metropolitan Asylums Board is unique. In fact, turning merely to such reports of hospitals as I happen to have at hand, and without instituting a search into a number of like documents, I find that, in other hospitals, general as well as special, the same fact has been observed. Thus, Mr. Mullens, superintendent of the Wilton Hospital, Salford, in his annual report for 1890, writes: "It is worthy of note that the three nurses who contracted enteric fever had been in constant attendance upon patients suffering from that disease, and that no nurse in attendance on patients ill of any other disease contracted enteric fever." In the reports of the City of Glasgow Fever Hospitals for the years 1897 and 1898, I find it stated that, amongst the cases of infectious disease contracted by members of the staff of the Belvidere Hospital in the discharge of their duties, there were six cases of enteric fever in the former year and three in the latter; while for the year ending May 31st, 1899, of eighteen such cases of infectious disease, eleven were enteric fever. Dr. Boobbyer, in the paper to which I have already alluded, gives Tables showing the number of admissions of enteric cases, and the number of cases of enteric fever arising amongst the staff for the ten years 1889 to 1898, for the Nottingham General Hospital and the Nottingham Children's Hospital; they were, respectively, for the former hospital 858 and 22, and for the latter 157 and 11.

All these figures are quite at variance with Murchison's statement that "hospital experience lends little support to the doctrine of contagion. . . . . it is universally admitted to be a very rare occurrence for the nurses or medical attendants of hospitals to contract enteric fever from the sick under their care."* I cannot help thinking that some, at least, of the evidence upon which his statements are based was imperfectly recorded. Curiously enough, at a time when a discussion on this subject was being carried on in the pages of the *British Medical Journal*, Dr. Seymour J. Sharkey contributed a paper† in which he related the cases of three nurses at St. Thomas's Hospital, all under the care of Dr. Murchison, who, there was every reason to believe, had contracted the disease from patients they had nursed; and Dr. Donkin‡ gave three similar instances that occurred at the East London Hospital for Children at

* *Loc. cit.*, p. 461.
† *Brit. Med. Journ.*, November 6th, 1880.
‡ *Ibid.*, vol. ii, 1880, p. 740.

Shadwell. But all examples of this nature do not appear to have carried weight; and we still find it stated in the last edition of Murchison's book as follows: "My experience, in fact, has led me to the conclusion that when enteric fever originates in a hospital, as a rule there is something radically defective in the sanitary arrangements, and that either the air or drinking-water is polluted with decomposing excrement. In rare instances . . . . . the attendants alone suffer; but when this happens, it is a fit subject for enquiry whether the poison be not generated in the decomposing alvine evacuations, instead of emanating directly from the bodies of the sick;"* and further, Dr. Cayley, the editor of that edition, referring to Dr. Collie's cases at Homerton, stated that to attribute the infection to direct contagion from fresh stools was so contrary to the experience of other hospitals, that it was impossible not to suspect the existence of some other cause.

These opinions have held the field ever since, and when a case of enteric fever occurs amongst the staff of a hospital, search is at once made for defects of drainage. But these are by no means always found. It is true that "the some other cause" suspected by Dr. Cayley was believed by Mr. Shirley Murphy to be, in the case of the Eastern (Homerton) Fever Hospital, an absence of ventilation of the drains.† Granting this defect of ventilation to have been present, it does not by any means follow that Dr. Collie's interpretation of the cases by direct infection was not the right one. I certainly am inclined to agree with him.

The experience of the Eastern Hospital during the past eight years has been very similar to the experience of the years (1871-1878) with which he dealt; with this difference, that somewhere about the year 1883, the whole of the drainage system was reconstructed under the supervision of a most experienced architect; this reconstruction including the addition to each ward of accommodation for w.c.'s, etc., in a tower or turret absolutely cut off, by a space open to the air, from the ward itself. I may further point out that, since October, 1898, the cases of enteric fever have been treated in a block of two wards which was erected in 1895, and which contains all the most approved sanitary arrangements up to that date; and that, as Table I shows, enteric fever has attacked the staff in the three newest

* *Loc. cit.*, p. 463.

† *Brit. Med. Journ.* November 6th, 1880.

hospitals of the Asylum Board, the Brook, the Park, and the Grove.

Concerning the ten cases at the Brook Hospital, Dr. MacCombie has kindly informed me that five of them occurred in the persons of nurses working in the enteric wards, including an assistant nurse, who came straight from the Broughton Sanatorium, where she had been nursing enteric patients, and who joined the Brook Hospital during the incubation stage of the disease; while of the other five, two were men whose duty it was to keep the floors of the enteric wards polished. With respect to the three cases at the Grove, the most recently-erected hospital, I am indebted to Dr. Beggs for the information that they were two assistant nurses and a wardmaid, all of whom for nearly two months had worked in enteric wards. It was the duty of the wardmaid to carry the soiled linen to the tank.

I will conclude this portion of the subject by quoting Dr. Boobbyer's remarks concerning the occurrence of the disease at the Nottingham General Hospital.* He writes as follows: "In 1892, I was requested by the authorities at the Nottingham General Hospital to examine the drains, or other possible agents of infection, at that institution, with the view of accounting, if possible, for the occurrence of a series of cases of the disease amongst members of the hospital staff. The result of my examination was entirely negative, so far, at any rate, as concerned any satisfactory explanation of the outbreak among the staff. I am driven, therefore, to the conclusion that the cases must have originated in the manipulation of the typhoid patients and their dejections."

Personally, I must confess that, with me, Dr. Collie's argument on this point carries great weight: namely, that if enteric fever amongst the staff of a hospital is to be attributed to faulty sanitary arrangements, especially in connection with the drainage, we should find the disease occurring more frequently amongst the patients who are not suffering from the fever than appears to be the case.

Finally, I will deal with the last grand argument of those who disbelieved in the infectivity of enteric fever. They pointed out that, when a case was introduced into a ward of a general hospital, the disease did not spread to the other patients; and they also drew attention to the fact that, although amongst the cases sent to the fever hospitals

* *Loc. cit.*, p. 104.

certified to be suffering from enteric fever, there was a very large number suffering, not from that disease at all, but from quite different complaints, yet it was an occurrence of great rarity for one of the latter to catch the infection, even though he was treated in the enteric ward. Now, although both these statements are in the main true, they cannot be said to be conclusive of the non-infectivity of the disease. They bear rather on the degree of infectivity, and the conditions which favour the spread of infection. As a matter of fact, instances could be cited in which there was reason to believe that a case of enteric fever *did* convey the infection to other patients in the ward; for example, I will refer you to Dr. Sharkey's paper, referred to previously, and to Dr. Cayley's Croonian Lectures, in which cases from the Middlesex Hospital are given. No one doubts the infectiousness of typhus; yet many instances could be adduced where this disease failed to spread in the wards of a general hospital. "It is very rare for typhus to spread from one patient to another occupying a contiguous bed," said Dr. Bristowe and Mr. Holmes in their well-known *Report on the Hospitals of the United Kingdom.** "Such an occurrence is rare (it not unknown) even in the Fever Hospital, and we are not aware that such an event has occurred at either St. George's or St. Thomas's Hospital. As regards the latter institution, it is an interesting fact that, since it has occupied its temporary site (about 15 months), it has had admitted to it at least 20 or 30 cases of typhus; but that, although one nurse during this period has contracted the disease and died of it, no patient has caught it, notwithstanding that the wards contain 84 beds apiece, and that many of the beds are placed back to back, touching one another."

It is also certainly very rare for a patient suffering from some other disease, admitted to an enteric fever ward, to catch that complaint. But, again, the only legitimate inference to be drawn from this fact concerns the degree of infectiousness and the mode of conveyance of the infection. As a result of an enquiry instituted by the Asylums Board a few years ago, it was found that, during two consecutive years, of 425 cases sent to the Board's hospitals as enteric fever, which after admission were found not to be that disease, only one was subsequently attacked with it (0.2 per cent.); while of 1202 cases wrongly sent in as diphtheria, 26 subsequently caught that disease (2.1 per cent.).

* *Sixth Report of Medical Officer of Privy Council*, p. 539.

This figure (2.1), though ten times that for enteric fever, is yet small in itself; no one, however, doubts the infectiousness of diphtheria. Scarlet fever is very much more infectious; according to returns made by Dr. Birdwood, in his annual reports for 1893 and 1894, 201 patients not suffering from scarlet fever were admitted to the North-Eastern Hospital (where the isolation accommodation was limited) during those two years, and 47 of them caught the disease (23.3 per cent.).

In connection with the above returns, there is one observation I should like to make. The incubation period of enteric fever is long (10 to 21 days) compared with that of diphtheria. The average length of stay in hospital of the cases of "other diseases" varied in the different hospitals from 16 to 31 days in the case of diphtheria, and from 17 to 27 days in the case of enteric fever. Hence, there was more opportunity for a case of enteric fever, infected in hospital, to have escaped inclusion in the returns by reason of the disease not declaring itself till after the discharge of the patient, than was likely in the case of diphtheria.

I have now reviewed such of the arguments on both sides of this question, as have either occurred to me or been brought to my notice by the writings of others. Personally, I am strongly inclined to side with those who hold that enteric fever is much more readily and directly communicable than is commonly supposed. There is abundant evidence to prove that the infection is conveyed in the stools, and lately it has been shown that it can also (perhaps very often) be transmitted in the urine. Petruschky, of Dantzig, relates a case in which the sister of a ward, having accidently drunk a small quantity of urine which had been passed into a wine-glass by a typhoid patient, developed the disease after an incubation period of twelve days.* The evidence of clinical medicine and of sanitary science goes to show that the other excreta and secreta of the patient are rarely, if ever, the vehicles of infection. Bacteriological research confirms this evidence; for what has been done in this direction I must refer you to the admirable Gulstonian Lectures recently delivered by Dr. Horton Smith. The mode of transmission of the *contagium vivum* serves to explain how it is that at well-administered hospitals the disease does not appear to be infectious when comparison is made with certain other

* *Brit. Med. Journ.*, June 5th, 1898.

infectious disorders. But when little or no care is exercised in the removal of the stools or urine, and in the cleanliness of the patient and his surroundings, it is not difficult to understand how the infection is transmitted to other persons, either in a moist state by way of the fingers, drinking-utensils, etc., or in a dry state through the air. And most of those Medical Officers of Health whose writings I have consulted, point out that it is especially amongst the poor, where the conditions of life are less favourable to cleanliness, and where ignorance and carelessness are more rife, than amongst the well-to-do, that enteric fever is so often observed to be directly infectious.

Discussion.

The discussion was opened by Dr. Foord Caiger, Medical Superintendent of the South Western Hospital of the Metropolitan Asylums Board, who said: I am sure that all members of the Society here to-night have listened with the very greatest interest to Dr. Goodall's paper, which forms a fitting opening to what is a most important subject. I cannot help thinking that, perhaps, Dr. Goodall has somewhat underrated the appreciation by the profession generally to the direct infectivity—or, if I might be excused a somewhat ancient term—the contagiousness of enteric fever, at any rate by those members of the profession holding appointments in hospitals. When we see what very great care is taken in reference to those details of management which have for their object the prevention of the spread of disease, one cannot help feeling that perhaps a wider appreciation of the fact exists than Dr. Goodall suggests. At any rate, to those of us who are in the daily administration of a fever hospital, into which enteric fever is admitted, I may fairly say, that for a good many years we have been alive to this possibility; so much so, indeed, that it has become a matter of conviction. Dr. Goodall has mentioned that in the Asylum Board Hospitals a large number of the staff, in the course of eight years, have developed enteric fever, no doubt in connection with their work; and he has given us the experience gained at his own hospital; and it may be of interest to the members of the Society if I relate the experience which we have gained at the South Western Hospital. I think one may say that the experience there confirms even more strongly the opinions and con-

clusions to which Dr. Goodall has arrived. In the course of nine years, during which enteric fever has been admitted there, twenty-three members of the staff have contracted enteric fever, and three of them have died. Of these twenty-three members every one was a nurse, and, with one exception, every one of these nurses was nursing in the enteric fever wards. When you consider that the proportion of enteric-fever nurses to the whole of the nursing staff is only something like one in fifteen, this fact is very striking.

I believe that I am right in saying, that in the course of nine years only one patient developed enteric, notwithstanding the fact that something like twenty or more per cent. of the admissions into the enteric wards were not cases of enteric fever at all. Dr. Goodall has suggested that this may be somewhat misleading, because the patients may have developed it after they got home. But I do not think that is likely, for we should have got them back again, and that did not occur in a single instance. It is interesting to note any facts which may be observed in connection with the development of these cases among the nurses, in order to arrive at some conclusion as to how they arose. I am afraid there is very little to be said in that respect. We have certainly noticed that the times at which the staff develop enteric fever are usually times of pressure, when the nurses are particularly hard-worked.

Another fact we have noticed is, that in four instances two members of the staff were attacked practically at the same time; and that rather implies that there was probably some specially infective agent at work at the time. It would suggest to me that there was, perhaps, one case in the ward giving off infection in greater quantity or of greater intensity than the average. Now, it is an interesting fact that but one single person engaged in the work of another ward was infected by enteric disease, and that she was the only one affected who had not the manipulation of the patients or their linen. So that the experience gained at the South Western Hospital, to an even larger extent than the Eastern Hospital, shows that members of the staff affected were those who alone had the manipulation of the patient or his linen. I take it, in organising administrative rules, having in view the prevention of a danger such as the taking of enteric, one should bear two things in mind: in the first place, to limit the possibilities of harm to the fewest number of persons possible—to exclude all others,

except the nurses who, of course, have to run risks; and, in the second place, to educate those people who have to do with the infection, as far as possible, to a true knowledge of what they are doing, and how best to avoid the risk; and that object is kept prominently in view, I may say, in all of our hospitals.

At my own hospital, the ward-maids are not allowed to touch the enteric fever patient at all—only the nurses. The nurses are instructed to remove the soiled linen at once from the ward, place it in an enamelled bucket, with a cover and a handle, and set it outside the ward door; and then these buckets are taken to the tanks and emptied out by the ward servants. They do not touch it. The manipulation of linen is entirely limited to the nursing staff. As to the nurses, we give them a printed copy of regulations, which contain practical points of advice in respect to their nursing work; and, in the case of enteric, the nurse is particularly enjoined to at once remove the soiled linen from the ward; to make a point of keeping the patient and his linen scrupulously clean, to invariably wash their own hands after having "changed" a patient, and to wash their hands before going to meals. They are instructed to keep the lavatory thoroughly well-ventilated, and not to use anything in the way of disinfectants, but to trust to free flushing and absolute cleanliness. Having given the nurse careful instructions, we feel we have done everything we can, except to stand over her and see to her detailed work: which is impracticable. Besides which, the nurse is told that, in case of feeling "off colour," she is to report herself to the matron, and never to go on duty without having eaten a fair meal. In spite of care, we find that, in the course of nine years twenty-three nurses have taken the disease. It is possible, of course, that we do not know all about the method of infection, and that we have a good deal yet to learn in that respect. I can confirm the opinion which Dr. Goodall has expressed as to the value of the recent Gulstonian Lectures of Dr. Horton Smith, in which he shows most clearly a considerable advance in our knowledge; and the fact that urine is possibly a frequent source of infection cannot be too much insisted upon. Although we are now arriving at the fact that urine is chiefly infective, I do not think that we yet take that care of the linen soiled by the urine that the facts of the case warrant. I believe, however, that it is only a question of time before more care is taken in that direction. The actual method of transmission of the disease between a patient and the

recipient opens up a field of speculation. I think few people would deny the very practicable possibility of the fingers becoming infected with linen or excreta, and perhaps in that way arriving at the mouth by handling the food. But I do not think there is sufficient appreciation of the fact that infection may be derived from a patient by means of some dried discharge which, owing to the movement or the manipulation of the patient or the bed-clothes, gets into the air in the form of dust, and so is inspired by the attendant. I cannot help thinking myself, although I have no evidence whatever of it, that infection in the case of the personal attendants of the enteric sick is very frequently accomplished in that way; just in the same way as the early powdering of scarlet fever may prove particularly infectious. This fine powder shed by the patient collects between the sheets, and any movement made may, with a puff of air, send the dust in the direction of the nurse, who is very likely to inspire it. In this way, no doubt, infection is very often transmitted.

Just a word more with regard to Dr. Goodall's statement that the incubation of enteric fever lasts between ten and twenty-one days. I do not wish for a moment to question that general statement, as in most cases it is no doubt quite true; but I think we should be alive to the possibility of the incubation in some cases being very much shorter. I do not know whether any members here to-night saw a most categorical statement which appeared in one of the medical journals about a year ago, reporting an instance which occurred in Germany of the spread of enteric fever amongst a certain section of the troops—it was during the autumn manœuvres—in which a certain detachment or regiment, moving from one town to another, in the course of their march halted for a few hours at a village. This village was infected with typhoid; a certain number of the soldiers drank the water of the well, and a larger number did not. Enteric fever broke out amongst those who drank the water, though there was not a single case amongst those who abstained: in other words, the disease, entirely limited to those who drank the water, was obviously conveyed by it. The incubation in these different men varied very considerably; the longest was twenty-six days and the shortest was less than three days. The conditions were striking; and from that time I have modified my own teaching, believing that the incubation of enteric fever may be in some instances considerably less than is usually supposed.

Dr. E. F. WILLOUGHBY thought that after all there was no real difference of opinion, for no one believed in distant aerial diffusion, as of small-pox or measles, and all agreed as to the infectivity of the excreta and urine. The mode of direct communication of the infection from the sick to the healthy was almost always what he called "eating with unwashen hands," just as the painter contracted lead-poisoning; and in the direct as well as the indirect means of communication enteric fever and cholera were alike. Every instance adduced by Dr. Goodall was capable of being thus accounted for, and Dr. Caiger's experience furnished the strongest confirmation of the conveyance of the infection by the hands. It was only in hospitals where the nurses were overworked, and in the cramped rooms of the poor, that such infection was observed, being never met with in the houses of the well-to-do, where every precaution could be enforced. He had met with but one instance of direct personal infection among persons in comfortable circumstances: that of a man who kept to his business in spite of exhausting diarrhœa, the nature of which he never suspected until his young wife, who had frequently washed his soiled linen, was attacked with typical—and, in the end, fatal—enteric fever. With regard to the exceptionally short incubation in the cases referred to by Dr. Caiger, it was in that communication pointed out that the fatigue of a long march, without food, in very hot weather, had rendered the men specially susceptible, though the subsequent fever was of the mildest type.

Professor LANE NOTTER: We are all indebted to Dr. Goodall for his interesting Paper. It opens up rather a wide field. I am one of those who believe that enteric fever comes from either eating or drinking what has become infected. I think the evidence before us is very clear. It is now nearly five years since I drew attention to the urine being capable of carrying the infection. To my own knowledge, the disinfection of the urine has been neglected, whilst stress has been laid on disinfecting the stools only. I think the evidence goes to show that it is the actual attendants upon the sick who contract the disease. I may mention a case that occurred where an orderly, who was most extremely careful in all his ways of dealing with cases of this sort, drank some of the fluid from the same cup the patient had been drinking out of, to see whether it was hot or cold, and was thus supposed to contract the disease. Familiarity breeds contempt, and when you get

nurses in enteric fever cases, they cease to recognise the danger that exists, and they do not take the precautions necessary in order to save themselves from a direct attack. I have seen cases of enteric fever treated in ordinary wards, and I have never seen a man in the next bed become infected with enteric fever. In fact, I have never seen, as far as I can remember, an ordinary enteric fever case, which has been carefully treated, cause infection; and our experience in the service is that nurses rarely catch it. One or two have done so, but it is a very rare thing; and it is so rare that it is almost a negligible quantity. As to the propagation of enteric fever by means of exhalations from the skin, I do not think that it is possible; and if we consider the large number who suffer from this disease, the infection would be much more marked than it is if that were so. Certainly, there is no evidence on record at all that lead us to suppose that the infection was anything akin to typhus fever. We know that contact is one of the means for conveying it to individuals. The history of this disease in this country, and in America, shows that it is by the contamination of food or water that enteric fever is generally propagated, either by dirty hands or by some indirect means; and that it is not infectious, certainly to any great extent, in any other way. In this connection, I would call attention to the point, which is not a new one, of the disinfection of the urine being equally as important as that of the bowel discharges.

Dr. BULSTRODE: May I, in the first place, express a hope that there will be many speakers upon this interesting subject, in order that their views may be recorded in the *Transactions* of the Society, and the discussion be available for reference purposes. I think there can be no doubt that a great change has taken place in the opinion of the Medical Officers of Health throughout the country upon this subject. The view is certainly gaining ground that enteric fever is more directly communicable from the patients to the nurses and attendants than was formerly supposed. As to what this change of opinion is due, it is somewhat difficult to determine. It may be due to closer and more accurate observation on the part of the observers; it may be due to a certain change of type in the disease. I think we cannot altogether overlook the question of change of type, having regard to the variations which are recognised as having taken place in the behaviour of certain infectious diseases from time to time. The

experience of the present day is certainly entirely opposed to the experiences of the London Fever Hospital. And if we accept, as we surely must, the investigations of Dr. Murchison, then, apparently, we are face to face with two somewhat opposing sets of facts: one pointing in the direction that the nursing of enteric fever is almost entirely free from risk; the other tending to the conclusion that the risk, even under the best conditions, *quâ* prevention, is considerable.

But there is one question which Dr. Goodall has touched upon, that perhaps he has not pressed home as he quite intended to do; and that is the difference in the ages of the nurses who were employed to nurse the sick in the olden days, and those who are so employed at the present day. My own experience was obtained under Dr. Caiger at the South Western Fever Hospital; and it used, at the time of which I speak, to be the custom to put the typhoid-fever patients chiefly under the care of the assistant nurses, who were, as a rule, young. In the old days of the London Fever Hospital, I think I am right in saying the nurses were more advanced in age, and hence, in that sense, less liable to contract the disease than the nurses of the present day. I have looked through the statistics of the Asylums Board, and I find that the greatest number of cases of enteric fever occurred amongst the assistant nurses. That the chief incidence of the disease should manifest itself upon the members of the staff is to be expected upon a statistical basis; but, nevertheless, the facts also tend to support the age-incidence view, *i.e.*, that this increase in attack on the staff is perhaps due, in part at least, to the age of nurses. I have been in communication with Dr. Hill, the Medical Officer of Health of Birmingham, upon the subject of to-night's discussion, and I had hoped that he would have been present this evening. Dr. Goodall has already quoted from his Report, and therefore I need not do so. In the letter which I have had from Dr. Hill, he says: "The infectivity of enteric fever has been too much lost sight of; but I have succeeded in convincing the Health Committee of its reality, and arrangements are now going on to provide hospital accommodation for all who are willing to avail themselves of it."

Dr. Niven, the Medical Officer of Health of Manchester, has also devoted much attention to this subject in his Annual Report for 1897. He says: "The behaviour of enteric fever at private houses is entirely different from that which it displays at a well-managed hospital; and the

very common idea that enteric fever is not a directly infectious disease, or at all events, not so in a high degree, is a most fallacious one." Dr. Niven then gives the history of what he terms "immediate infections" during 1897, and he adds: "From this statement it may be perceived that no fewer than 53 cases out of 484 could be traced to direct infection. If we add to these the cases occurring in public institutions, about one-seventh may be traced to immediate infection. This furnishes, I believe, a true picture of the disease as it behaves in large towns."

It was Dr. MURCHISON'S opinion that "Hospital experience lends little support to the doctrine of contagion." But it seems to me that, if we are to test this question of direct infectivity, it is to the fever hospitals that we must look for it. Outside the hospitals, there is the difficulty of excluding the continued operation of the first cause of infection. We cannot, as a rule, definitely determine that the cause is not continually operating, and that the different dates of attack may not be due either to the different dates of ingestion of the specific organism, or to a temporary resistance to its influence. But inside the hospital we have, as a rule, conditions which enable us to almost demonstrate that enteric fever is directly communicable from the patients to the nurses. It is not necessary to discuss the precise limitations to be placed upon the terms "infection" or "contagion." It is simpler to use the term "directly communicable;" and from this point of view there is ample evidence pointing to the conclusion that enteric fever is often communicable from patient to nurse, and therefore that the nursing of the typhoid fever is a more dangerous occupation than is usually thought. Dr. Caiger has told us of the measures which are taken at the Stockwell Fever Hospital to prevent the nurses from contracting the disease; and he has also given us the figures, which show, that in spite of these precautions a very considerable number of the nurses have contracted the disease. We must not, however, overlook the fact that what may be termed the infectivity of the disease may vary considerably in different outbreaks or epidemics, and from one year to another. Certainly, in some large outbreaks the element of infectivity seems to play a prominent part, while at others this element may not be apparent. We have heard to-night as to the treatment of enteric fever in the wards of general hospitals. Well, one cannot always make public all one knows; but I venture to predict that in the course of another decade,

when this subject is more fully digested, and the infectivity of enteric fever properly appreciated, this practice will be considerably curtailed, if not entirely disallowed.

Dr. PETRONELL MANBY: It might be of some interest if I were to refer to a small outbreak of typhoid at Liverpool recently, which points to direct infection. We have heard a great deal to-night of the experience in hospitals, but these were not hospital patients or nurses at all. The cases occurred in the Adelphi Hotel, about last December. There were three cases of typhoid fever which occurred among the staff, one after the other, in the course of a few days. The first case was a man—I do not know where he picked up the disease—known as the kitchen clerk. He sat in the kitchen in a little glass office, and received slips from another clerk in the office adjoining. This man sat in this office from 8.30 o'clock in the morning until six o'clock in the evening; but from half-past six to half-past eight his place was taken by another person, who sat in the same little office. This person was the next to get typhoid fever; and the third case was the person who sat in the outer office and handed the slips through to these other two people. It may be said, of course, that this is not sufficient evidence of personal infection; but it was all the evidence we could get. There was the direct communication of work, and possibly the communication of disease in the same way. Although there were many other servants in the hotel, eating with these people in the same mess, and so on, no other servant developed the disease, and no visitors, as far as we knew, developed it, so that that would be against food infection.

With regard to the question generally, I am inclined to agree with Dr. Goodall, that the infectivity of typhoid fever is not sufficiently appreciated at the present moment by the general practitioner, though people engaged in public health work may, in large measure, think seriously of it. One found this out over and over again at Liverpool, where one had a great deal to do with the removing of cases to hospital, and was met by the patient's friends, saying: "The doctor says there is no possibility of any infection in such cases whatever." It seems to me that Dr. Goodall is doing good work in this process of education, by controverting a popular fallacy.

Dr. MATTHEWS: It may perhaps be useful to relate an experience which occurred in the Fountain Fever Hospital

one year ago. A patient was admitted to a diphtheria ward, and after a few days was found to be suffering from typhoid fever as well as diphtheria. Subsequently, two other patients in that ward developed typhoid. The mode of infection could not be determined, but there was no reason to suppose contamination of the patient's food or water had taken place. I believe that the point alluded to by Dr. Bulstrode might prove most instructive, and that is the question of the treatment of typhoid fever in general hospitals. It would be interesting to learn what is the experience of general hospitals which take typhoid fever into their general wards. I have reason to believe that instances are not rare of patients in these hospitals, as well as staff, contracting typhoid from patients admitted with it. I do not say typhoid is as infectious as scarlet fever, but the frequency with which it spreads amongst nurses is sufficient witness to its danger; and I am therefore unable to regard the possibility of typhoid fever being a directly infectious disease as a negligeable hypothesis.

Dr. W. A. BOND: My limited experience quite corroborates everything that the author of the paper has stated. In one large Hospital—Guy's—in almost every instance where a nurse has contracted fever, I have ascertained that it has been through nursing a typhoid patient; the same with other hospitals in another district (Holborn). I think all medical practioners ought to emphasise the importance of all nurses being careful with the urine of patients with typhoid fever. I am under the impression that a great many of the secondary cases, especially among nurses, arise from nursing cases of typhoid fever. We are all aware that in the medical text-books most stress is laid upon the stools; and in most of the printed instructions to nurses that I have seen, the only emphasis is laid upon the instruction that the nurses have to be very careful about the stools. I was very much impressed, some years ago, when reading an account that typhoid bacilli had been found in an enormous number from patients suffering from typhoid fever; and that has been brought out in the Goulstonian Lectures; in fact, the enormous number of five hundred millions per cubic centimetre has been found in the urine of typhoid patients. That is a point that all medical practitioners ought to emphasise. It is a point which is very much forgotten by the general practitioner.

I am glad that Dr. Bulstrode mentioned the varying

infectivity. I quite agree with that, and recent bacterialogical researches have proved that there are great differences in the serum reactions of typhoid bacilli when grown in different media.

Dr. WILFRED E. FLETCHER: It appears to me that we have too much faith in the assumption, from the fact that nurses contract the disease after nursing typhoid patients, that therefore the disease is infectious in the ordinary sense of the word.

I do not think that that fact justifies the belief that the disease must be necessarily infectious, apart from the question of swallowing the bacilli in food or drink. Every precaution possible may be taken by nurses in washing their hands and avoiding the use of vessels used by patients; but there may sometimes be a lapse. Nurses may forget to wash their hands, and it is almost impossible to exclude the chance of their being careless in that respect. With regard to another matter: we know that the urine and the excrement are infectious; may not secretions, as well as excretions, be so? I came across the case of a medical man in Lancashire. While operating for empy-aema upon a subject suffering from typhoid, the patient coughed, and some of the pus was ejected into his face. He contracted typhoid, and died of that disease. It had been endemic in the town in which he practised, and it is quite possible that, in the duty of attending patients, he may have been infected. But still, in his case, shortly before he became ill, he had this pus from the typhoid patient squirted into his face, and it is very possible some went into the mouth, and was swallowed with the saliva, and pus has been known to contain typhoid bacilli.

The PRESIDENT: It seems to me, before we can discuss with any profit the question of whether it is infectious or contagious, we want to know what we mean by "infectious" and "contagious." The words themselves represent a past rather than the present stage of medical knowledge. The distinction between infectious and contagious is one that hardly holds good at the present day. Diseases which are spread by micro-organisms are communicable from person to person by one or other channel, and we know that even those which have the longest "striking distance" are spread by small solid particles, and therefore may be said to be contagious; at the same time, those small particles

are in the form of dust, which may be conveyed by the air, and therefore they may be said to be infectious. The distinction is, therefore, not one which can be very well maintained. There can be no doubt that enteric fever is a communicable disease through one channel or another. That it is communicable by the fæces no one doubts, and it probably is also by means of other excreta. Dr. Murchison was of opinion that fresh enteric fæcal matter was harmless, and that it was only when the excreta had become decomposed that they became dangerous; but that may have been based, to some extent, on the circumstance that in certain media the typhoid bacilli will multiply considerably outside the body: thus, in water containing organic matter, they undergo a great multiplication. Therefore, fæcal matter that has been passed for some time may have generated a very much larger amount of infective particles than were present in it when it was first passed. But that typhoid excreta are infective immediately they have been passed there can, in my opinion, be no doubt. The opinion as to the non-infectivity of typhoid fever seems to be largely drawn from text-books, written by hospital physicians; and under the circumstances in which typhoid fever is treated in hospitals, with ample cubic space, with careful nursing, and atttention to cleanliness and disinfection, and so on, it does not spread widely. The patients in adjoining beds very rarely contract the disease, and the medical attendants do not very often contract it; but the nurses who are brought into close contact with the patients do contract it. Whether this is wholly conveyed by means of the handling of soiled linen may be questioned. We may conceive channels through which the infection may be taken in by the breath, as well as by the alimentary canal. As Dr. Fletcher has mentioned, a certain amount of congestion of the lungs is found in every case of typhoid fever; ulceration of the larynx also sometimes occurs; and if the bacilli be present in the mucous secretion, they may be carried up into the air. If a person coughs in a beam of sunshine, you see minute particles scattered in the form of spray. The sordes which collects about the mouth of a typhoid patient, and the intestinal flatus which he passes, may be thought of as possibly containing the typhoid bacillus. From such sources particles conveying the bacillus may be inhaled by another person, and either be carried into the respiratory tract, or be deposited upon the mucous membrane of the mouth or pharynx, and so swallowed. It is going too

far then to say that the disease can only be swallowed in food or drink. Where there is a midden system, or the custom prevails of depositing the excrement on the surface of the ground, it becomes dust and is scattered by the wind; and possibly may be not only deposited on food, but also inhaled in the form of dust.

Because typhoid fever is not very communicable from person to person under the conditions of a hospital, it does not follow that it is not readily communicable under the conditions existing in the houses of the poor, where all facilities for its prevention, which I have mentioned, are absent. When I was a student, I was told that the disease was not infectious; but when I came to see it in practice among the houses of the poor, I soon found that an introduced case was often followed by one member of the household in succession after another being taken with the disease—if that is not infection, the word "infection" is entirely misleading. As Dr. Manby has said, to say that the disease is not infectious, when we know that the disease spreads from person to person till the whole household is infected, is a gross misuse of terms, and is most detrimental to the interest of the public health. Therefore, I think it would be of very great use, that the view which has been so largely held by speakers at this meeting should be brought before the profession and the public, and the danger of the communication of typhoid in households more clearly pointed out. The very last outbreak of typhoid fever which I had personally to investigate was one in a row of six cottages: more than a fourth of the inmates suffered; the first cases having probably been contracted in a neighbouring town. Mediate transmission through the usual channels, such as drains, privies, water-supply and milk-supply, entirely failed to account for the spread of the disease, and personal communication seemed the only agency to which it could be attributed.

Another instance was that of a Norfolk village, where the first case was introduced, and its nature was not recognised by the medical man, and the disease spread from one household to another in the village, from patient to nurse, through a number of houses. The water supply was good, and other sanitary conditions were also good; and the only thing which seemed capable of accounting for it was this personal contagion.

We are much obliged to Dr. Goodall for his carefully-prepared and interesting paper.

Dr. GOODALL, in reply, said: I endeavoured to show that typhoid, when first differentiated from typhus fever, was considered to be infectious. Then observers went to the other extreme, because they wanted to make out a greater difference between typhus and typhoid; and it finally became a leading doctrine that typhoid was not communicable directly from patients to those in attendance upon them. With respect to what Dr. Caiger has said about the South Western Hospital, my impression is that when we have got the wards full of cases of a severe type, and when nurses are working at high pressure, then they contract the disease. As regards the question of the General Hospitals, we have not got evidence from them because they rarely give statistics of illness occurring among the staff. But, as I have quoted, typhoid fever seems to have been prevalent for several years in the Nottingham Hospital. Yet it is of these hospitals that Dr. Murchison quotes the physicians as stating that they rarely have cases of typhoid fever occurring amongst the staff. The age of nurses is one of the things I had in my mind; but I did not go so fully into it, as the paper had already reached a great length. The question of age-incidence was one very largely insisted upon by Dr. Collie, in the *British Medical Journal* twenty years ago, in a controversy with Mr. Shirley Murphy. Dr. Collie's contention was that, most likely, the difference of incidence of the disease in the two institutions was due to some question of difference of ages of the staff. My recollection, however, is that Mr. Murphy did not quite agree with that contention of Dr. Collie's; but, unfortunately, neither side brought forward exact evidence. There was no table given of the ages of the nursing staff from either of those institutions. The question has been raised, as to whether the infection can be discharged from a patient by other channels than by the excretion of the bowels and by the urine. Whatever views one may have, it is difficult to prove whether it is so or not. Dr. Horton Smith says, that when a typhoid patient gets pneumonia, it is rare to find the bacilli in the sputum or the lungs; so that bacteriological evidence goes to show that it is chiefly by the alvine dejections, and by the urine, that the infection is conveyed. Although, perhaps, a patient may possibly give off infection by the lungs or the skin, it is not likely to be the case. With respect to dust there is evidence to prove that the bacilli may be conveyed by that medium; and I take it that infection occurring through dirty privies and middens is conveyed in that way. Although I knew

that, in fever hospitals, the view was strongly held that direct infection took place, I was rather surprised to see how many Medical Officers of Health throughout the country also held that view very strongly. I am quite sure that those are wrong who teach—as is evidently taught by the leading text-books—that there is no risk in nursing enteric fever patients, and that there is no necessity for removing an enteric fever patient from his home to hospital.

ON IMMUNITY AND RESISTANCE AS FACTORS IN THE EPIDEMICITY AND ENDEMICITY OF INFECTIVE DISEASES.

By HERBERT E. DURHAM, Grocers' Research Scholar, Pathological Laboratory of University of Cambridge.

(*Read*: *May* 18*th*, 1900.)

It may be laid down as an axiom that persons or animals which are harbouring the specific organisms of diseases affecting human beings are to be regarded as dangerous to the community. It may be likewise deduced that if such individuals are actually suffering from typical attacks of a given disease, they are more likely to be dealt with as such, than if they are suffering from unrecognisable or unrecognised forms of the disease, and still more than those that are not suffering at all, although more or less infested with the causative agent of the disease.

In comparatively recent decades there was an optimistic belief that the specific infective maladies were characterised by very definite adherence to type; for it was not appreciated that a given infective agent might cause extremely different symptoms according to the nature of the individual infection. To take an example: an organism like the pneumococcus may give rise to a typical pneumonia, to an empyema, to an acute cerebro-spinal meningitis, or to an acute osteomyelitis, or to a purulent peritonitis; whilst each of these may demand special forms of clinical treatment, yet so far as concerns their actual essential etiology, they are one and the same disease, though they differ in their pathology. But, beside such differences, which are due to varied manner of manifestation, we have to recognise variations in intensity of attack. The intensity of attack depends upon two main factors, both of which are variable according to laws of which we have as yet but little knowledge. One of these factors is the variation in resistance of the host, the other is the variation of the infective agent; the latter may vary in its infective or resisting power, or in its power of poison-production, or, again, in both of these.

At present we are concerned with the variations in receptivity of the host; and with our scanty knowledge of the laws which govern the variations of the parasite, this side of the question may be left alone. It is well known that different individuals, varieties, species and genera vary considerably in their susceptibility towards virulent organisms—they may be more or less refractory by nature, or they may have acquired a specific immunity, either by reason of the direct action of the agent upon them, or by reason of transmission of such acquired immunity in some degree from their mother; *i.e.*, an insusceptibility independent of the germ plasm (the transmission of the agent may also happen).

In any case, whether the proneness to resist infection be due to a non-specific resistance or to a specific immunity, it must be remembered that the power is limited. We *know* of no instance of either a naturally refractory animal, or of an artificially specifically immunised one, which is proof against the introduction of a sufficient amount of a sufficiently virulent material.

We may distinguish three classes of individuals for present purposes:—

1. Those who have recently had attacks and are considered recovered; here, in so far as their recovery is due to specific reaction against the cause, their immunity or resistance to continuance of the malady is of specific nature.

2. Those who have had attacks at more remote periods, but who have retained sufficient specific antagonism to resist illness when exposed to possible infection; here the mechanism is specific.

3. Those who have never suffered from an attack, so far as can be ascertained. Of these subdivisions must be made: (*a*) those who have entirely escaped the influence of the infecting agent, non-specific; (*b*) those who have passed through unrecognised or unrecognisable attacks, specific; and (*c*) those to whom some specific immunity has been transmitted (not truly inherited) from the mother, who herself may belong to either of the classes given.

Individuals (both man and lower animals) may be carriers of the given infecting agent, to whichever of the classes they may belong.

In respect to class 1, it must not be assumed that when an individual has apparently recovered he has necessarily ceased to harbour the infective agent. Infective agents will be of greater importance if they are carried on the surface, or passed in excretions, than if they are confined to

latent foci within his system. In the case of *diphtheria*, it is well known that *B. diphtheriæ* may persist about the upper air passages for months after apparent recovery from all illness. In *enteric-fever* cases, the *bacillus typhi abdominalis* may persist in the urine for considerable periods (Petruschky, Horton Smith). In *plague*, cases have been described where *B. pestis* continued in the sputum thirty to forty-eight days after the complete cessation of fever, and when the diphtheria patients were apparently well (Gottschlich*). The bacilli thus found were proved to be fully virulent for guinea-pigs.

It will probably be admitted that in such cases, an individual, though apparently well restored to health, may really be a danger to his fellows.

As an instance of refractory animals retaining infecting agents, some experiments with the *micrococcus melitensis* may be cited. Guinea-pigs are comparatively refractory to this organism; of a number of these animals which were infected, some died at considerable periods after the injection, the longest survivals were seventy-four and ninety-four days; in both of these the presence of the *coccus* was determined in certain of the organs as well as in the urine. Other animals which survived four, six, eight, and ten months were killed, and cultures were made to see whether the *coccus* was still present. In all of the cases the *coccus was found, generally abundantly, in the urine.*

A. Killed after four months; growth only from kidney and urine.

B. Killed after six months; large piece of spleen and loopful of urine both gave growth; other organs *nil.*

C. Killed after eight months; growth from local caseous nodule, kidney (large piece), spleen (loop), femoral marrow (*wholly* from one femur), and urine (one drop).

D. Killed after ten months; growth from two drops urine; organs (both large pieces and single loops remained sterile).

These observations are not without interest in showing with what tenacity an organism may remain in the urine of an animal† and be diffused by it. (It may be noted that no case of "laboratory infection" occurred during the course of these observations).

From this we may pass to diphtheria. It has been found by a number of observers that the blood-serum of some untreated horses ("normal") possessed a more

* *Zeitschr. f. Hygiene*, xxxii, p. 402.

† Birt and Lamb failed to find the *micrococcus* in the urine of the human cases examined by them.

or less considerable quantity of a substance, which had the power of neutralising diphtheria toxin; the most carefully worked-out cases are those of Dr. Cobbett, who showed that the relations of the neutralising substance with different diphtheria filtrates agreed with those possessed by proper antitoxin of diphtheria; and that so far as present methods go, there was no doubt that the substance in question was truly diphtheria antitoxin. At the same time it must be stated that a very considerable number of horses have been tested, and shown to possess no appreciable neutralising power whatever in their serum. The presence of the antitoxin is therefore no normal condition of the horse, and the inference is that it is an acquired character. It may be doubted whether such a character can be acquired without the presence and action of the diphtheria bacillus or its products. Horses, I believe, are not known to be affected with diphtheria as such; but it does not follow that they may not harbour the bacillus at times in such a way as to engender the production of true antitoxin.

Whatever interpretation may be placed upon these data, the possibility of the horse acting as a disseminator of diphtheria cannot be entirely excluded.

From these considerations we are led to deal with the presence of apparently virulent diphtheria bacilli in the throats of persons who are not suffering from manifest illness, and the presence of neutralising power of the blood-serum (for diphtheria toxin) of persons who are not known to have had diphtheria.

Many observers have recorded instances where diphtheria bacilli have been demonstrated in the throats of persons not suffering from the malady; several of these were, more or less, in attendance upon diphtheria patients. The serum of persons who had not suffered from diphtheria have been examined by a number of observers: Wassermann found that of the serum taken from thirty-four adults, as many as twenty-eight showed definite power of neutralising diphtheria toxin; in most of the cases 1cc of the serum was able to neutralise ten fatal doses when given in mixture; in the remaining cases no neutralising power could be found. He also examined seventeen children of 1½-11 years of age; four of these had no neutralising power, and in two there was delay in the time of death of the guinea-pigs, when, as before, ten fatal doses were given with the serum; the remaining eleven showed strong neutralising power. Fischl and Wünschheim also found neutralising

power in sixty-eight out of eighty-two samples of serum obtained through the umbilical cord from *placentæ* (*i.e.*, blood of the child); in some instances 1cc was able to neutralise twenty fatal doses of diphtheria toxin.

Perhaps the most interesting investigation of this sort is that of Loos,* who examined the blood-serum of a number of children. One of these was tested, and found to have little or no neutralising power; later, it became affected with diphtheria, and was again examined on two occasions: namely, fifteen and sixty days after the illness. In both of these samples, antitoxic action was found—more markedly, however, at the second examination. Two other cases failed to show action during the course of diphtheria; but examination after recovery showed that they, too, had acquired it. Lastly, in two children who were healthy, but in whose throats virulent cultures of diphtheria bacilli were obtained, strong antitoxic property was discovered in the serum. Such modes of inquiry are worthy of further study, especially in cases where healthy individuals are found to be harbouring true diphtheria bacilli. In the children's portion of the Charité Hospital in Berlin, there had been frequent outbreaks of diphtheria; it was consequently decided to make routine prophylactic injections (two hundred immunisation units every three weeks). During a period of five months (Slawyk), observations were made upon one hundred children. In twenty-four instances, diphtheria bacilli were found in the throat without any symptoms accompanying their presence; in four cases diphtheria occurred (in respect to these, it is stated that, for certain reasons, prophylactic injections had not been properly carried out). It is not possible to be certain whether the twenty-four children, or some of them, would have escaped illness notwithstanding the bacilli, if the serum had not been given; moreover, their serum was not tested for neutralising properties. Still, it is not impossible that the occurrence of the malady in the wards may have sometimes been spread from individuals amongst whom the presence of diphtheria bacilli had not been suspected. When an individual has a considerable degree of natural resistance (as in the case of the rat), or acquired immunity, either passive by serum or active by absorption of bacillary products, it certainly is an advantage to the individual; but, in so far as he may unsuspectedly carry about virulent diphtheria bacilli, his peculiarity may be disadvantageous for his fellows.

* *Wien Klin. Wochenschr.*, 1896, p. 455.

Recently, I have paid some attention to the dysentery which occurs in lunatic asylums, and which does not appear to differ materially in its nature from the dysentery of other countries. It appears probable that the disease is transferred from one individual to another, by some more or less direct means. Besides the cases which are recognisably dysenteric, one finds that a good many cases of intermittent or protracted diarrhœa occur. Occasionally, opportunity is afforded of examining the condition of the colon in such cases; and in several instances it has been found riddled with ulcers of a nature resembling those seen in the less highly acute dysenteric cases. It is probable that these cases of diarrhœa form links which assist in keeping the disease endemic, especially as they do not give any apparent reason for care in the disposal of things which may have been infected.

It is, of course, impracticable to deal with every member of a community, and it would be especially difficult in the case of those who do not suffer during an epidemic. But it should be remembered that it may not be the severe and the slight cases only which contribute to the origin and spread of a disease. It is possible that the causative agents may be carried by individuals who, by reason of natural insusceptibility or by reason of an acquired specific immunity, may show no signs that they are doing so. It may, therefore, sometimes be of value to search for objective signs (specific organisms) amongst such apparently unpromising material. As a modification of an old commonplace saying—"Whatever you do with the pounds, pay some attention to the pence."

SEASONAL VARIATIONS IN AGE-DISTRIBUTION OF DEATHS FROM CERTAIN INFECTIOUS DISEASES.

By SHIRLEY F. MURPHY.

In 1898 I presented to the Society a short Paper, showing that when the cases of scarlet fever and diphtheria notified in London are examined, it is found that the age-distribution of the cases is subject to seasonal variations; and further, that there is also seasonal variations in the fatality of these diseases. In the accompanying diagram are shown these variations, based on the cases notified in the period 1892-8. Inasmuch as the figures for the period 1892-7 were published in vol. xvii, of the *Transactions*, it is unnecessary to do more than state that the figures for the period 1892-8 will be found in my report to the London County Council for the year 1898. I am unable to show similar curves for measles and whooping-cough, inasmuch as cases of these diseases are not notified in London; but in the accompanying diagram will be found curves of seasonal variation of age-distribution of deaths from measles and whooping-cough, as well as from scarlet fever and diphtheria. Owing to the unequal age-distribution of the deaths from these diseases, it has been necessary to show the proportion to the deaths at all ages; of the deaths under one year of age in the case of measles and whooping-cough, and of the deaths under five years of age in the case of scarlet fever and diphtheria. The diagram shows curves based upon these proportions, occurring in the ten years 1889-98.

It will be seen, by reference to the diagram, that whereas deaths from scarlet fever and diphtheria among persons at the younger age occur in the greatest proportion in the early months of the year, attaining their maximum in April, deaths from whooping-cough and measles among such persons occur in greatest proportion in the middle of the year: in whooping-cough attaining a maximum in August, and in measles attaining a maximum in July, the proportions showing definite curves throughout the twelve months.

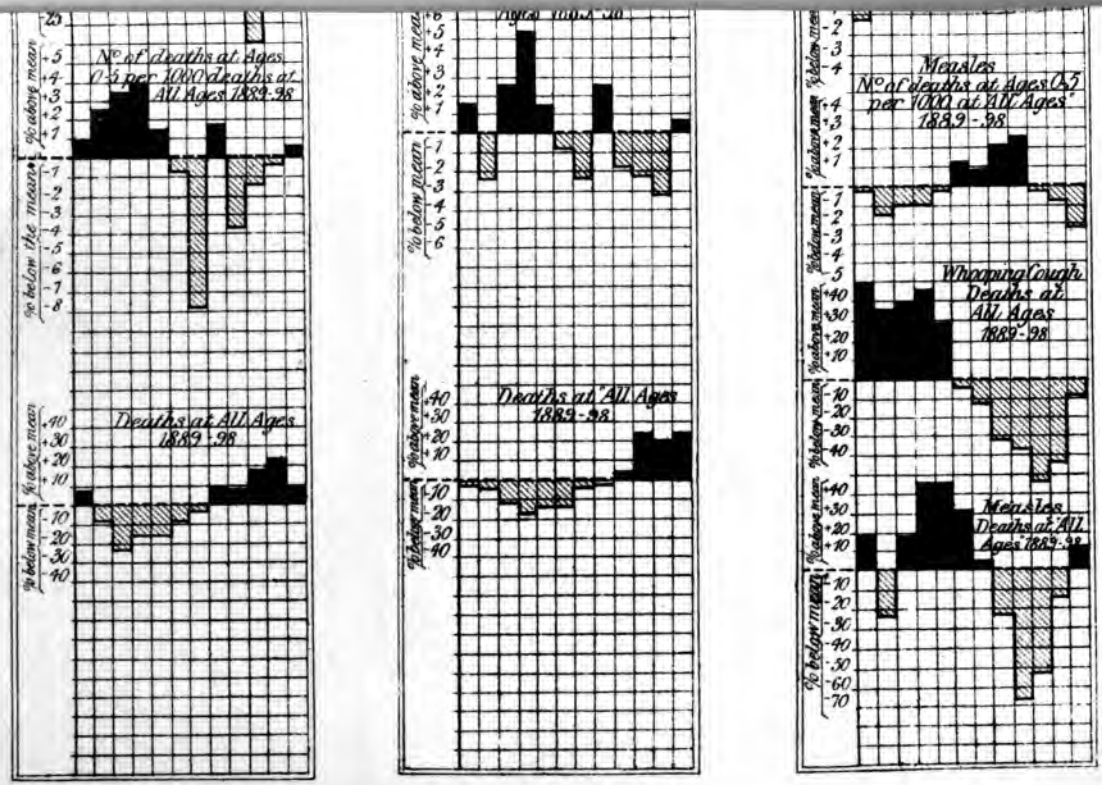
The figures on which the curves are based will be found in the following Tables:—

Diphtheria—London, 1889-98.

Month.	Registered Deaths, 1889-98.				
	All Ages.	0-1	1-5	5-20	20 and Upwards.
January ...	1,610	103	1,004	459	44
February ...	1,595	91	965	493	46
March ...	1,820	127	1,140	508	45
April	1,357	84	885	353	35
May	1.391	94	859	400	38
June	1,732	97	1,067	522	46
July	1,531	79	932	483	37
August ...	1,592	96	1,011	441	44
September ...	2,068	131	1,245	643	49
October ...	2,003	107	1,218	620	58
November ...	1,961	104	1,184	619	54
December ...	2,562	141	1,605	735	81

Diphtheria—London, 1889-98.

Month.	"All Ages" taken as 1,000.			
	All Ages.	0-5	5-20	20 and Upwards.
January ...	1,000	688	285	27
February ...	1,000	662	309	29
March ...	1,000	696	279	25
April	1,000	714	260	26
May	1,000	686	287	27
June	1,000	672	301	27
July	1,000	661	315	24
August ...	1,000	695	277	28
September ...	1,000	665	311	24
October ...	1,000	661	310	29
November ...	1,000	657	316	27
December ...	1,000	681	287	32


% above mean
% below the means
% above mean
% below mean
N° of deaths at Ages 0-5 per 1000 deaths at All Ages 1889-98
Deaths at All Ages 1889-98
% above mean
% below mean
% above mean
% below mean
Deaths at All Ages 1889-98
% above mean
% below mean
% above mean
% below mean
% below mean
Measles
N° of deaths at Ages 0-5 per 1000 at All Ages 1889-98
Whooping Cough Deaths at All Ages 1889-98
Measles Deaths at All Ages 1889-98

Scarlet Fever—London, 1889-98.

Month.	Registered Deaths, 1889-98.				
	All Ages.	0-1	1-5	5-20	20 and Upwards.
January ...	737	34	474	212	17
February ...	636	43	402	169	22
March ...	684	28	454	179	23
April	598	25	398	160	15
May	593	30	380	171	12
June	798	35	505	233	25
July	678	28	398	220	32
August ..	771	51	484	217	19
September ...	944	73	547	292	32
October ...	829	54	503	244	28
November ...	848	62	514	253	19
December ...	1,000	54	630	287	29

Scarlet Fever—London, 1889-98.

Month.	"All Ages" taken as 1,000.			
	All Ages.*	0-5	5-20	20 and Upwards.
January ...	1,000	689	288	23
February ...	1,000	700	266	34
March ..	1,000	705	262	33
April	1,000	708	267	25
May	1,000	692	288	20
June	1,000	677	292	31
July	1,000	628	325	47
August ...	1,000	694	281	25
September ...	1,000	657	309	34
October ...	1,000	672	294	34
November ...	1,000	679	298	23
December ...	1,000	684	287	29

Whooping-cough—London, 1889-98.

Month.	Registered Deaths, 1889-98.				
	All Ages.	0-1	1-5	5-20	20 and Upwards.
January ...	2,652	899	1,652	119	2
February ...	2,405	930	1,404	69	2
March ...	3,110	1,180	1,815	114	1
April	2,585	1,027	1,457	93	8
May	2,266	920	1,265	80	1
June	2,110	914	1,131	64	1
July	1,571	707	813	49	2
August ...	1,224	594	593	34	3
September ...	1,408	588	774	46	—
October ...	776	315	448	12	1
November ...	972	352	585	35	—
December ...	2,146	761	1,319	65	1

Whooping-cough—London, 1889-98.

Month.	"All Ages" taken as 1,000.				
	All Ages.	0-5	1-5	5-2	20 and Upwards.
January ...	1,000	339	615	45	1
February ...	1,000	387	584	28	1
March ...	1,000	379	584	37	—
April	1,000	397	564	36	3
May	1,000	406	558	36	—
June	1,000	433	536	30	1
July	1,000	450	518	31	1
August ...	1,000	485	485	28	2
September ...	1,000	418	550	32	—
October ...	1,000	406	577	16	1
November ...	1,000	362	602	36	—
December ...	1,000	355	614	30	1

Measles—London, 1889-98.

Month.	Registered Deaths, 1889-98.				
	All Ages.	0-1	1-5	5-20	20 and Upwards.
January ...	2,484	440	1,908	133	3
February ...	1,621	323	1,190	104	4
March ...	3,062	600	2,264	188	10
April	3,049	608	2,247	190	4
May	3,037	674	2,197	153	13
June	3,398	769	2,485	136	8
July	2,141	544	1,497	94	6
August ...	1,611	388	1,170	51	2
September ...	931	217	687	23	4
October ...	936	167	716	52	1
November ...	1,779	310	1,360	104	5
December ...	3,032	527	2,277	220	8

Measles—London, 1889-98.

Month.	"All Ages" taken as 1,000.				
	All Ages.	0-1	1-5	5-20	20 and Upwards.
January ...	1,000	177	768	54	1
February ...	1,000	199	735	64	2
March ...	1,000	196	740	61	3
April	1,000	199	737	63	1
May	1,000	222	723	51	4
June	1,000	226	732	40	2
July	1,000	254	699	44	3
August ...	1,000	241	726	32	1
September ...	1,000	233	738	25	4
October	1,000	178	765	56	1
November ...	1,000	174	765	58	3
December ...	1,000	173	751	73	3

OBITUARY.

Sir Richard Thorne Thorne, K.C.B., F.R.S.*

On December 18th, 1899, the Public Health Service sustained a heavy loss by the sudden death of Sir Richard Thorne, the Medical Officer of the Local Government Board. Embolism, consequent on phlebitis, was the cause of this sudden removal from our midst of one whose name had long been closely associated with sanitary administration and sanitary progress.

Sir Richard Thorne was born at Leamington on October 13th, 1841. In his earlier school-days he was for a time at Neuwied, in Prussia, and afterwards at the Lycée St. Louis, Paris, for a considerable period. The thorough knowledge of the French language that he acquired at the latter institution stood him in good stead in relation with certain of his official duties in later life. His school education was completed at Mill Hill; whence he went to St. Bartholomew's Hospital to take up the study of medicine. He graduated in medicine at London University in 1866, obtaining first-class honours in medicine and in obstetric medicine. After holding the usual minor appointments at his hospital, he was appointed physician to the Royal Hospital for Diseases of the Chest, and also assistant-physician to the London Fever Hospital.

Soon after this, he took the first step in the path which he was to follow with such distinction to himself and advantage to his country, by becoming associated with the Medical Department of the Privy Council, on whose behalf he conducted several inquiries into public health matters. This occasional employment was followed by his appointment as a medical inspector under the Privy Council in 1870; and when, in 1871, the Local Government Board was constituted, Sir Richard Thorne (then Dr. Thorne) became a Medical Inspector under that body. From that time to the day of his death he remained in the service of the Local Government Board: attaining, in 1892, the high and responsible position of Medical Officer to the Board, in succession to the late Sir George Buchanan.

* A portrait of Sir Richard Thorne will be found in the beginning of this volume.

Sir Richard Thorne was so gifted that success would have attended him in any one of the several careers open to members of the medical profession. But the most striking, perhaps, among his many gifts was his singular ability as an administrator; and by a happy choice or a fortunate accident, in joining the medical staff of the Local Government Board, he associated himself with a service in which such a gift is of pre-eminent value.

In his discharge of the varied duties of an Inspector of the Board, he disclosed power of careful research, rapid grasp of the essential points in complex questions, and remarkable judgment and tact in his dealings with local authorities and their officers. His reports to the Board were models of what such reports should be: omitting nothing essential, yet brief and lucid. Among the most noteworthy of these reports is that, issued by the Local Government Board in 1882, on the use and influence of hospitals for infectious diseases; which still ranks as a standard work on this subject.

In due course, Sir Richard Thorne was promoted from the Inspectorate to the position of an Assistant Medical Officer to the Board; and, in 1892, he became the Medical Officer. In this post, full scope was afforded to his genius for administration and organisation. During his period of office, not only had he to discharge the responsible duties ordinarily devolving upon the head of the Medical Department of the Local Government Board, but he had also to organise a scheme of defence against the threatened invasion of this country by cholera in 1892 and 1893; and again, in later years, against a like danger from plague. How promptly and how well this work was done is matter of common knowledge. And, indeed, this work, known to all, is typical of all that Sir Richard Thorne did. Shrewd, ready, and practical, he dealt with complex and far-reaching problems with astonishing rapidity, and with exact appreciation of the course of action to pursue. He knew the measure of each member of the staff that worked under him, and no complexity of detail in any question ever lessened his grasp of the real issue. These gifts he possessed in common with all good administrators; but, in the almost intuitive readiness with which he reached a sound conclusion, he had a quality higher and rarer: a quality seldom found even in the ranks of good administrators. A man so gifted may justly be considered as more than talented: he has the inspiration of genius.

Another duty, beyond the routine work of his position,

that fell to Sir Richard Thorne was that of acting as British delegate to several international conferences convoked for the consideration of international measures of precaution against cholera, plague, and yellow fever. In this capacity he attended the International Conference at Rome in 1885, that at Venice in 1892, that at Dresden in 1893, that at Paris in 1894, and that at Venice in 1897. In the proceedings at these conferences the language spoken was French, and Sir Richard Thorne's familiarity with this tongue, combined with his thorough knowledge of the subjects discussed, rendered his services peculiarly valuable. It was during the period embraced by these conferences that the majority of the European Powers abandoned quarantine in favour of measures less harmful to commerce, and more in accordance with the principles of modern hygiene. No small share in this happy result was due to Sir Richard Thorne's tact, ability, and perseverance; and thus he aided in conferring a double benefit on the nation which is at once the chief commercial country in the world and the pioneer of sanitary progress.

Notwithstanding his many duties at the Local Government Board, Sir Richard Thorne found time for other work. He was lecturer on hygiene at St. Bartholomew's Hospital, and during many years the students of that institution benefited by his gifts of clear and pithy exposition. In 1891 he delivered the Milroy Lectures, selecting as his subject "Diphtheria: its Natural History and Prevention." As Harben Lecturer in 1898, he dealt with the administrative control of tuberculosis. He was a member of the Royal Commission on Tuberculosis appointed in 1896, and of the Royal Commission on Sewage Disposal, appointed in 1898. He was also Crown member of the General Medical Council. On all these three bodies he did good public service, and by all his judgment was held in high esteem. He was a member of many public health societies at home and abroad. His connection with the Epidemiological Society dates back as far as 1871, in which year he became a member. He was Treasurer of the Society from 1880 to 1886, and was its President from 1886 to 1888.

Many honours and distinctions were conferred upon Sir Richard Thorne. In 1890 he was elected a Fellow of the Royal Society. In 1893 the Stewart Prize was conferred upon him. In 1898 he was made an honorary LL.D. of the University of Edinburgh, an honorary D.Sc. of the Royal University of Ireland, and an honorary Fellow of

the Royal College of Physicians in Ireland. In 1892 the distinction of Companion of the Most Honourable Order of the Bath was bestowed upon him; and in 1897 he was promoted to be a Knight Commander of the same Order.

No one merited these distinctions better than Sir Richard Thorne; and, regarded as tributes to his ability, they are grateful testimony to those who knew him that his merits did not pass unrecognised. But in their hearts he has a higher tribute: the tribute of affection and esteem, given with full knowledge of the man and of his work.

He died in the prime of his intellectual vigour; and his country is the poorer by the loss of a faithful and most able servant.

"I have fought a good fight, I have finished my course." Sir Richard Thorne might well have said the first: would that he had lived to say the second in the fuller sense.

T. T.

The Ordinary Meetings of the Society are held at

11, CHANDOS STREET, CAVENDISH SQUARE,

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THE CHAIR IS TAKEN AT HALF-PAST EIGHT O'CLOCK P.M. PRECISELY.

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The Transactions for the Sessions 1859-60, 1866-67, *and* 1867-68 *are out of print. With these exceptions, those for the Sessions from* 1860-61 *to the last Session inclusive, may be obtained from the publishers,* Messrs. SHAW AND SONS, FETTER LANE, E.C. *Prior to* 1859-60, *the Transactions were published in the "*SANITARY REVIEW." *The issue of a New Series of the Transactions was begun in* 1882.

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